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Re-inventory of Conocephalinae species from district Sanghar

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Abstract
The present study determined the re-inventory of Conocephalinae species of family Tettigoniidae grasshoppers from District Sanghar. A total of 218 samples were collected from the field during the year 2017. Obtain material was sorted out into following 06 species i.e. *Conocephalus maculatus* (Le Guillou, 1841), *Euconocephalus pallidus*, Redtenbacher, 1891, *E. incertus*, Walker, 1869, *E. indicus* (Redtenbacher, 1891), *E. mucro*, Do Haan, 1842 and *E. nasutus*, Thunberg, 1815. The morphological description of various species along with photographs was provided. Beside this, it was noted that Conocephalinae species feed on pine tree, rice, wheat, grass, sugarcane, edible podded and cultivated field and causes damage.

Keywords: Re-inventary, Conocephalinae, Tettigoniidae, Sanghar, species, damage

1. Introduction
Conocephalinae is a subfamily of Tettigoniidae. Tettigoniidae (Grasshoppers are the largest and most diverse group of insects. These are polyphagous in nature for this reason they damage most valuable crops in the whole world. Mostly rice, sugarcane, wheat, maize, barley, orchards and forests damage by this. Conocephalinae are cone headed bush crickets, meadow katydids. Their body is generally elongated in size moderate to small, they are mostly green and brownish in colour and sometimes having darker lines especially on pronotum, head is cone shaped, antennae are long than body and femur. Tibia have several spines on both sides but in few have no spines and wings are fully developed mostly long and slim, similar to grass blades or narrow leaves, male with well-developed but no magnified and basal stridulatory organs, female possesses a very long and curved upwards and sometimes slightly straight ovipositor. Considerable taxonomic work has been done on Caelifera of Pakistan by Ahmed [1], Wagan [2], Wagan & Naheed [3], Yousaf [4], Riffat and Wagan [5], but, no attention was paid to long-horned grasshoppers, the Ensifera therefore, the present study has been carried out for the first time in order to re-invent the species of this group.

2. Material and Methods
2.1 Sampling
Samples were collected during the year 2016-2017 from district Sanghar such as Khipro, Sinjhoro, Shahdadpur, Jam Nawaz Ali, Tando Adam and Sanghar, from forest, fruit orchards, cotton, rice, maize, wheat, sugarcane, groves, herbs and shrubs with the help of hand picking insect net, hand catching, disturbing by stick shaking and dislodging the plant stand traditional picking method. The total number of specimen were 218 and sorted out into 2 genera and 6 species i.e. *Euconocephalus incertus*, 1869, *E. indicus*, Redtenbacher 1891, *E. mucro*, Do Haan 1842, *E. nasutus*, Thunberg 1815, *E. pallidus*, Redtenbacher 1891, and *Conocephalus maculatus*, Le Guillou, 1841, were reported from district Sanghar. The recorded species were collected, identified and preserved in the Sindh entomological museum. The drawing line and measurement were also taken and their general characters were noted.

2.2 Killing and preservation
All the collected material was killed by the methods of Vickery and Kevan [6] and Riffat and Wagan [5]. The material was brought to the laboratory with very care and after that potassium cyanide (KCN) was used for only 15 – 20 minutes for killing samples.

2.3 Identification of the samples
All the preserved specimens in the insect boxes were examined by the Stereoscope Dissecting Binocular Microscope (OLYMPUS, SZX7, SZ2-ILST). All the entomological methods were applied for the identification including keys, description which is mentioned in different books, papers, articles by different scientist and photograph. The Orthoptera Species File (http:www.orthoptera.org) version 5.0,5.0 was also used for the identification and examination of the samples.

2.4 Morphometry
The specimens were measured under the microscope and if specimens were large then measured by using scale or compass. The measurement was taken in millimetre (mm). The illustrations were made by using ocular square reticule graph which was fitted in Binocular microscope on different magnification such as 1X, 2X and 4X. But I have used the 2X magnification for the illustration.

2.5 Statistical analysis
Different means and standard deviation were through Excel.

3. Results
Following six species were collected and re-described from district Sanghar

3.1 *Euconocephalus incertus* (Walker, 1869)
Diagnostic features
Body medium to large in size, lean or slim in shape. Generally body coloration is greenish or brown. Head is pointed and cone shaped. Pointed fastigium, wider beyond the antennae and fastigium separated from frons. Eyes are spherical and spaced but not oval in shape. Pronotum large, wider and it had side keels. Wings are fully developed and these wings are transparent with green veins. Tegmen leathered and tegmen short than wings. Stridulatory structure exhibited on tegmina from the left side. Hind femora exceeding beyond the end of abdomen. Hind femora and fore tibiae have spines on the ventral side. Cerci in male broad basally and it is slightly needle-shaped at the apex. Cerci in female slightly different from male cerci, cerci of female broad at the basally but it is thin at the apex. Ovipositor of female straight and long.

Remarks
E. incertus is widely distributed species all over the country. Previous entomologist collected this species from Ceylon, Penang, Tokin Calcutta, India, Burma, Philippines and Java Hebard [7]. During present study, this species has been collected from bushy vegetations of grasslands and also from Gum *Acacia* tree. Their local movement was also observed in field they Jump, walk and fly. The collection of this species shows that they are more abundance in Sanghar.

3.2 *Euconocephalus mucro*, de Haan 1843
Diagnostic features
Body medium to large size, silky brown coloration of body and shape of body is slender. Pronotum of this species larger than head, pronotum distally wider. Fastigium large fairly acute and stretched beyond the antennal sockets. Fastigium has dark spots laterally. Antennae have dark brown color. Wings and tegmen fully appeared. Costal edges of tegmen pale through, Tegmen has a series of light darkening is marked. Stridulatory structure lune shaped. Cerci broad at the basally and slim at centre, ovipositor is long and curved upwards.

Remarks
Previously, Tan [8] has reported 06 males of this species from Singapore. During present collection, single specimen of male *E. nasutus* has been collected from Sanghar. While, we have made many different trips at different dates in same localities but unfortunately we failed to collected female of this species. Its exact reason still unknown.

3.3 *Euconocephalus pallidus*, Redtenbacher 1891
Diagnostic features
Body medium to large size and slightly lean, green in colour, antennae dark brown in colour. Fastigium is short. Pronotum has keel, it's elongate in shape and wide. Wings and tegmen fully developed on tegmen structure (a narrow brown line on the extreme anterior edge of the tegmen is present). Fore tibiae have ventrally spines. Stridulatory structure is present at the left of tegmen and comparatively it is slender in shape. Cerci in male are ample at basal half and sharp at apex. Ovipositor of female long in size, slightly straight and thin at apex.

Remarks
The size of this species is medium, color green it occur in tall and thick vegetation of scattered grasses along with long Pine trees near the roadside. Earlier, this species collected from Burma, Calcutta, Singapore, India, Ceylon, Tokin, Java, Penang and Philippines. In contrast of Tan [8] *E. pallidus* smaller in size and it might be due to geographically variation of the region or might be due to less collection. Tan reported 07 males from Singapore. At the present, we have collected good numbers from different localities of district Sanghar.

3.4 *Euconocephalus indicus* Redtenbacher, 1891
Diagnostic features
Body medium sized, slender shaped, brownish in color. Antennae larger than body and brownish in color. Fastigium short and as long as broad, surpassing the antennal sockets, apex of fastigial vertex blunt and rounded. Covering on the pronotum towards (the side keels) the posterior edges at the dorsal side. Prosternum armed with a pair of spines. Fore wings long and have light brown veins, hind knees have rounded tips. Ovipositor larger than the body size and without curve.

Remarks
Hebard [7] reported few specimens of this species from Himalaya Mountain, Penang, Borneo and Sumatra. Redtenbacher [9] also reported only a single male of this species from Malaya. During present study, we have collected large number of male and female from district Sanghar. The body length of this species is medium to large in size and brownish in colour. Its extensive occurrence was confirmed in all areas of the district Sanghar.

3.5 *Conocephalus (Anisoptera) maculatus*, Le Guillou, 1814
Diagnostic features
This species have small body, with brown dorsal bands. Antennae's colour is dark brown. Fastigium of vertex broad. Eyes are narrower and outward. Prosternum is wide. Fore-wings are light brown and pigmented. Wings are brown with dark bands in costal and pre-coastal areas. Stridulatory structure of male forewing shaped. Hind femora armed from

ventral side. Tibiae have some dark spot at the base. Male cerci with one spine and cerci in female without spine. Ovipositor elongated relatively straight.

Remarks

This species reported from India, Andaman and Nicobar Islands, Kerala, Sikkim, Tamil Nadu, Hong Kong and Aferica. Earlier, this species was reported from hunan by Kang [13] and Xia & Liu [14]. Vegetation Zones, hilly and also from plan areas. During the present study this species collected from many different fields such as, cotton, wheat, rice and sugarcane from district Sanghar. Population of this species has seen in April and few in November.

3.6 *Euconocephalus nasutus*, Thunberg 1815

Diagnostic features:

Body is cylindrical in shape and medium to large size. Its body yellow greenish in color. Antennae pale brown in colour, on pronotum lateral green band and it is large in size. Fastigium of this species is blunt and small, fastigium stretched beyond the antennal sockets. Tegmen fully developed. On wings transparent cells are present with bright light green blood vessels. Hind femora and fore tibiae have spines on ventral side. Cerci of female acute at apex and cerci of male are broad. Ovipositor long and it is curved.

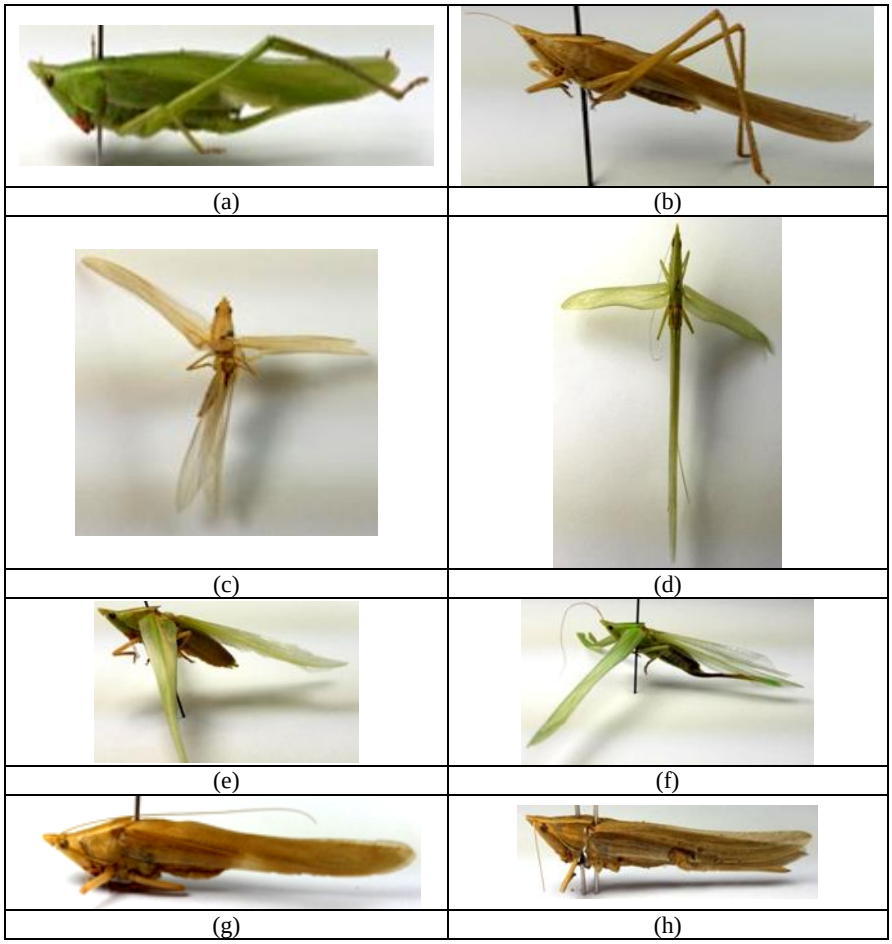
Remarks

Earlier, Hebard [7] reported one male and two females from Philippine Island in green and brown coloration. At present, we have collected single specimen of female *E. nasutus* from district Sanghar. This species showed the pale costal margins throughout the tegmina. The present observation generally matched with description of Hebard [7] except the costal margins of tegmina having some slight darkening apparent.

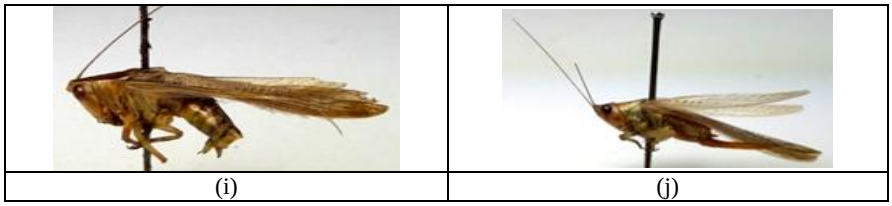
Table 1: Morphometry of various species of Conocephalinae

Body parameters	*E. incertus*		*E. mucro*	*E. pallidus*		*E. indicus*		*C. maculatus*		*E. nasutus*
	(♂)	(♀)	(♂)	(♂)	(♀)	(♂)	(♀)	(♂)	(♀)	(♀)
L.O.H	4.17±0.74	4.871.06	0.35	4.36+0.53	4.10+0.34	4.48±0.57	4.80±0.29	1.62±0.31	1.86±0.34	4.9
W.O.H	3.22±0.32	3.43±0.35	3.8	3.40+0.30	3.12+0.24	3.33±0.27	3.48±0.20	2.27±0.36	2.41±0.43	0.35
L.O.P	6.88±1.51	6.85±0.72	7	7.86+0.30	6.72+0.38	7.22±0.67	7.15±0.60	2.72±0.44	2.76±0.32	7.7
W.O.P	3.99±0.47	4.35±0.73	2.8	4.24+0.06	3.64+0.58	3.80±0.65	3.78±0.38	2.39±0.31	2.72±0.33	0.35
D.B.T.E	1.76±1.78	1.72±0.28	1.4	1.90+0.28	1.73+0.22	1.69±0.24	1.80±0.28	13.63±1.15	13.36±1.14	2.1
L.O.F	21.1±1.91	22.93±2.34	20	25.6+1.67	22.8+1.30	22.8±1.30	21.6±1.14	13.5±1.11	13.2±1.65	23
L.O.T	19.5±3.77	22.66±2.46	18	22.6+0.89	24.4+1.14	23.2±1.64	21.2±1.48	----	---	21
L.O.O	---	22.26±1.27	----	---	21.8+1.48	---	20.6±1.67	-----	---	22
T.B.L	29.6±29.8	30.66±4.02	32	32.4+2.60	30.6+0.89	28.8±3.83	32.2±2.86	-----	---	45

Note: L.O.H= Length of head, W.O.H= Width of head, L.O.P= Length of pronotum, W.O.P= Width of pronotum, D.B.T.E= Distance between two eyes, L.O.F= Length of femur, L.O.T= Length of tibia, L.O.O= Length of ovipositor, T.B.L= Total body length.



(a) (b) (c) (d) (e) (f) (g) (h)



(i) (j)

Fig 1: (a) *E. incertus* ♂, (b) Same but ♀, (c) *E. mucro* ♂, (d) *E. nasutus* ♀, (e) *E. pallidus* ♂, (f) Same but ♀, (g) *E. indicus* ♂, (h) Same but ♀, (i) *C. maculatus* ♂, (j) Same but ♀.

4. Conclusion

Conocephalinae are phytophagous in nature. These insects mostly found in wheat, sugarcane, rice, grapevine, fruit orchards, forests and cotton. This sub-family has described two genera and six species. This finding shows that if more survey will be carried out hopeful some new record and new species will be added in existing fauna.

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