# Song and morphology of some little known species of Gomphocerinae (Orthoptera: Acrididae) from Turkey with description of a new species

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Morphology and acoustic signals of four species of the subfamily Gomphocerinae (Orthoptera: Acrididae) from Turkey are studied. *Eremippus zeybekoglui* Mol **sp. n.** is described from Northern Anatolia. *Gomphocerus transcaucasicus* Mistshenko, 1951, **stat. n.** is considered as a distinct species, not a subspecies of *Gomphocerus sibiricus* (Linnaeus, 1767). Previously unknown male of *Dasypippus uvarovi* Karabag, 1953 is described.

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## 1. Introduction

Both morphology and acoustic attributes are very important taxonomic characteristics for some Orthoptera species. In previous studies, morphological characteristics were used to distinguish grasshopper species of the subfamily Gomphocerinae. In addition to morphological characteristics, acoustic characteristics are very important in determining the relationships of species. Males produce a species-specific calling song that is recognized by conspecific females. The songs of several groups of Gomphocerinae grasshoppers have been actively used for solving taxonomic problems, e.g. discrimination between sibling species or establishing the status of local populations showing small morphological differences (Bolivar 1899, Uvarov 1934, Ramme 1951, Harz 1975, Ragge & Reynolds 1998, Bukhvalova & Vedenina 1998).

Studies of the Gomphocerinae taxa of Turkey were started by Bolivar (1899). After Uvarov (1934), Ramme (1951), Bey-Bienko and Mistshenko (1951), Karabağ (1958) and Weidner (1969), the first significant information about the subfamily of Gomphocerinae of Turkey was provided by Demirsoy (1977), who reported 66 taxa. Then Çıplak *et al.* (1999) reported a total of 80 taxa belonging to 18 genera of Gomphocerinae. However, it seems that there are still some uncertainties and deficiencies in knowledge of some of the 18 genera of Gomphocerinae, for both the distribution and taxonomy. These are *Eremippus* Uvarov, *Gomphocerus* Thunberg, *Aerepedellus* Hebard, and *Dasyhippus* Uvarov. Of these four genera, 13 taxa have been recorded in Turkey until now (Çıplak *et al.* 1999).

In the present study I aimed to review some Anatolian species of the genera *Eremippus*, *Gomphocerus*, *Aeropedellus*, and *Dasyhippus*.

## 2. Material and methods

This study was carried out between 2004 and 2006 in Northern Anatolia in Turkey. During the

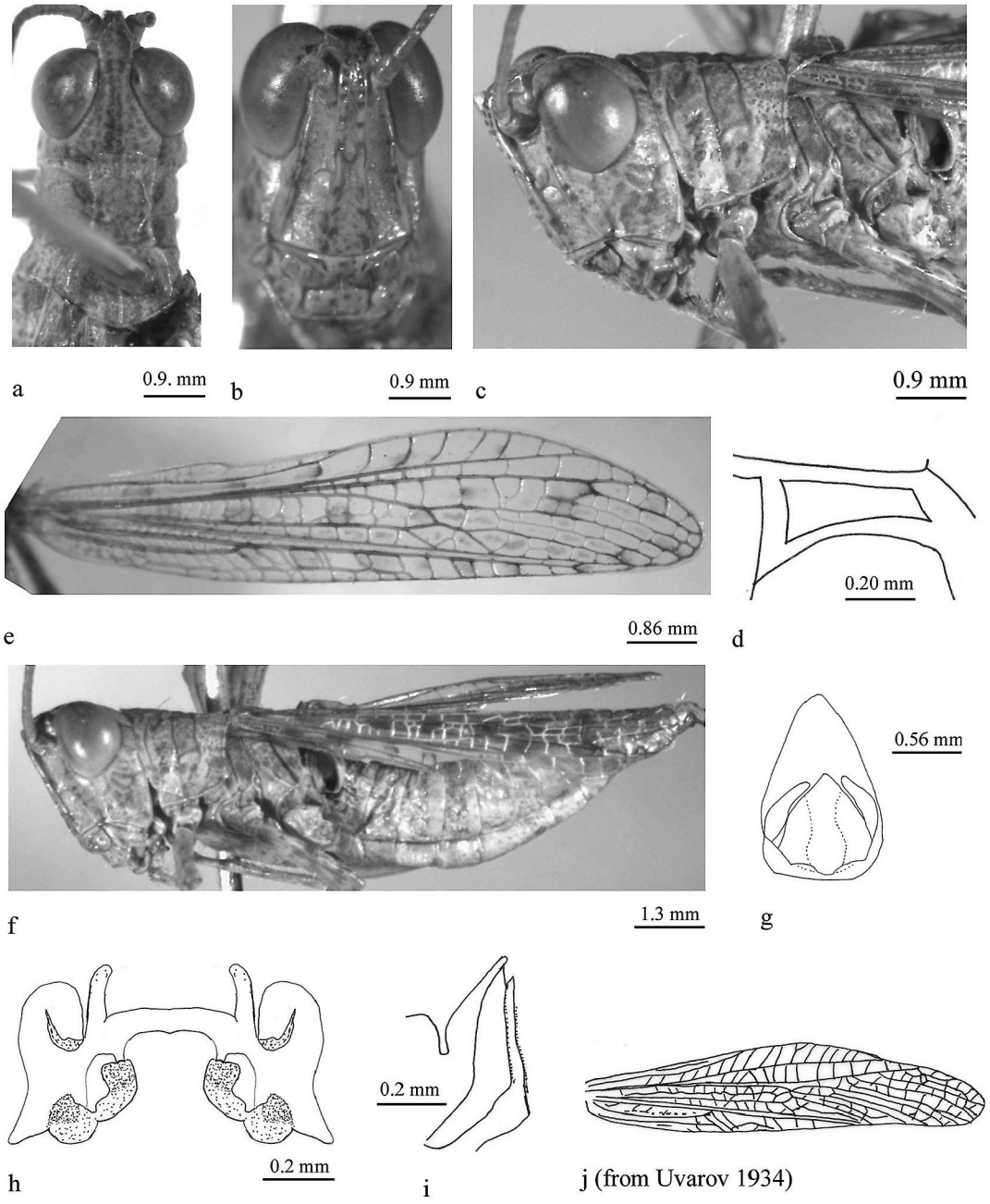


Fig. 1. *Eremippus zeybekoglui* Mol **sp. n.** male. – a. Head pronotum. – b. Frontal view. – c. Head pronotum laterally. – d. Faveolae. – e. Tegmina. – f. Body lateral view. – g. Supra-anal plate. – h. Epiphallus. – i. Penis. – j. *E. angulatus* male tegmina (from Uvarov 1934).

field work, songs of Gomphocerinae specimens were recorded and then they were collected by a sweep net. Specimens collected during the field studies were prepared as museum material by standard methods. Male genitalia were dissected and soaked into aqueous 10% potassium hydroxide (KOH) solution at room temperature. Figures and measurements were obtained using a digital camera or a camera lucida attached to a stereo microscope. The specimens were diagnosed by

comparing them with the species given by Uvarov (1930, 1934), Bey-Bienko and Mistshenko (1951), Weidner (1969), Harz (1975), Demirsoy (1975, 1977) and Salman (1978). Specimens examined during this study are deposited in Ondokuz Mayıs University, Department of Biology, Entomological Museum, Samsun, Turkey (OMUEM).

Field recordings of the songs were made with a Sony Cassette-Recorder WM-GX 688 and a flat Microphone (up to 14 kHz). Song recordings were made in the field in full sunshine and air temperature was measured in the shade. Male calling songs were analysed with the aid of Cool Edit 96 schedule and printed using Turbolab (Stemmer AG) program. The terminology for song description follows Ragge and Reynolds (1998). In song descriptions, seconds (s) or milliseconds (ms) were used for duration / intervals.

## 3. Taxonomy

### 3.1. Genus *Eremippus* Uvarov, 1926

*Eremippus zeybekoglui* Mol **sp. n.** (Fig. 1a–i)

*Material examined* (Holotype). North East Anatolia, Artvin: Yusufeli, Aşpişen Village, 600 m a.s.l., 17.VIII.2006, 1 ♂.

*Diagnosis.* The new species differs from *E. weidneri* Demirsoy, 1977 by its tegmina reaching to tip of abdomen (in *E. weidneri* male tegmina reaching to 7$^{th}$ tergite), the new species differs from *E. gracilis* Uvarov, 1934 and *E. turcicus* Ramme, 1951 by frontal ridge forming distinct angle with vertex in profile and the new species differs from *E. simplex* (Eversmann, 1859) by the third transversal sulcus located far beyond middle (in *E. simplex* located in front of the middle of median keel).

New species is similar to *E. angulatus* Uvarov, 1934 by frontal ridge forming distinct angle with vertex in profile, but differs from latter in compound eyes higher than vertex (in *E. angulatus* eyes as high as vertex), tegmina 4.3 times as long as wide (in *E. angulatus* 4.8 times), precostal field with notch nearly middle (in *E. angulatus* notch absent), maximum width of costal field 1.6 times as wide as maximum width of subcostal field (in *E. angulatus* costal field is same width with subcostal field), costal field and subcostal field with wide cells (in *E. angulatus* with narrow cells), subcostal field widened in apically (in *E. angulatus* widened middle), medial vein with two branches (in *E. angulatus* with three branches), medial field extend along proximal 0.6 of tegmen (in *E. angulatus* proximal 0.52 of tegmen), medial field turn towards first cubital field (in *E. angulatus* straight) (Fig. 1e, Fig. 1j), (Uvarov 1934, Demirsoy 1977).

*Description.* Holotype (male): Head slightly wider than pronotum (Fig. 1a); vertical diameter of eye / minimum width of vertex between eyes 3.25; vertical diameter of eye / length of subocular groove 2. Vertex acutely pentagonal anteriorly, surface concave, with a median keel; faveolae deep, little narrowed towards the apex, with lower margin slightly curved; well visible from above and 2.2 times as long as wide (Fig. 1d). Frontal keels ticked, slightly divergent toward clypeus (Fig. 1b); antenna filiform, longer than combined length of head and pronotum, its longest medial segment 1.92 times as long as wide.

Pronotum slightly constricted in the middle, its frontal margin slightly widened and hind margin obtusely rounded. Median keel distinct and entire, slightly raised in profile especially in prozona; first and second transversal sulci distinct, typical transversal sulcus (third sulcus) pass lateral and median keels; length of median keel before sulcus / after sulcus 1.17; lateral keels distinct and slightly convex in the metazona; the maximum / minimum widths between lateral keels 2 (Fig. 1a).

Mesosternal interspace wide, internal margins of the mesosternal lobes divergent backward and 1.7 times wider than long medially. Tympanal opening 2 times as high as wide in the middle (Fig. 1c). Hind femur long, its length 4.4 times longer than of its maximum width. Sternum and legs, especially first and second femora, with dense setae.

Tegmina reach to tip of the hind femur, 4.3 times as long as wide, gradually narrowing apical ward; its maximum width located near the middle. Precostal area reaches to middle of tegmina, with a distinct false vein and a notch near to its middle; costal vein distinctly sinuate at the base

of the tegmina; costal area widened in the middle and with widened cells, its maximum width 1.6 times wider than the maximum width of the subcostal field; subcostal field widened in the apex; radial vein almost straight, radial field wider than others; medial vein with two branches; medial field extend almost along proximal 7 / 10 of the tegmen, its maximum width 1.16 times wider maximum width of subcostal field and 2 times maximum widths of the first cubital field; first and second cubital veins separate (Fig. 1e). Stigma absent. Alea as long as tegmina and with white veins (Fig. 1f).

Abdomen: Subgenital plate with long and dense setae; cerci not reach to apex of anal tergum (Fig. 1g), its length 2.9 times longer than its greatest width. Two lobes of the epiphallus with big anterior and posterior notch (Fig. 1h); apical valves of penis with saw-shaped toward outer edges and shorter than cingular valves (Fig. 1i).

Coloration: In general appearance light brown with dirty yellow and blackish pattern dorsally and yellowish black ventrally; head and disk of pronotum dark brown and yellowish (Fig.1c); tegmina brownish, with dark spots along costal, radial and medial fields; hind femur same as body colour, with four blackish oblique band dorsally, yellowish ventrally; hind tibiae yellow-brown ventrally.

Measurements (in mm): Length of male body 12, head 2, pronotum 2.5, tegmina 8.8, hind femur 7.4.

Female: unknown.

*Etymology.* I am honoured to dedicate this new species to Prof. Dr. Unal Zeybekoğlu who has contributed to my doctorate thesis.

### 3.2. Genus *Gomphocerus* Thunberg, 1815

*Gomphocerus transcaucasicus* Mistshenko, 1951, **stat. n.** (Fig. 2a–i, Fig. 3a–d)

*Gomphocerus sibiricus transcaucasicus* Mistshenko in Bey-Bienko and Mistshenko, 1951: 489, fig. 1068 (holotype – male, Azerbaijan: Naxçivan (=Nakhichevan), between Geigel Lake and Tyllyak; in Zoological Institute, St.-Petersburg, Russia; not studied).

*Gomphocerus sibiricus transcaucasicus*: Karabağ 1958: 146; Weidner 1969: 206; Demirsoy 1975: 97; Demirsoy 1977: 225; Otte *et al.* 2011.

*Gomphocerus simbiricus* (sic!) *transcaucasicus:* Salman, 1978: 111.

*Material examined.* Artvin: Şavşat: Yukarı Kocabey Yaylası, 2,450 m a.s.l., 11.VIII.2004, 4 ♀; the same locality, 27.VII.2005, 16 ♂, 31 ♀; Ardahan: Hanak-Ardahan yolu, Hanak çıkışı, 2,100 m a.s.l., 11.VIII.2004, 3 ♂, 1 ♀; Erzurum: Oltu, Kırdağ Tepesi, 2,650 m a.s.l., 20.VIII.2000, 2 ♂.

*Diagnosis.* There are differences between *Gomphocerus transcaucasicus* and *G. sibiricus* as follows. Length of faveolae 2.75–3.75 times longer than width in both sexes (in *G. sibiricus* 2.5 times longer than wide), the ratio length of hind femur to maximum width of hind femur 3.95–4.1 in male, 3.78–4.32 in female, (in *G. sibiricus* 4.5 in both sexes), mesosternal interspace wide, 1.43–1.6 times wider than long in male, 1.6–2 times in female (in *G. sibiricus* as high as wide in both sexes), medial vein divided into two branches near apex in male, (in *G. sibiricus*, to three branches), precostal field with a false vein in both sexes (in *G. sibiricus* without false vein), radial and subcostal vein sinuate near middle of tegmina (in *G. sibiricus* straight), apical valves of penis saw-shaped and enter into itself (in *G. sibiricus* straight outer edges and not saw-shaped) (Harz 1975).

*Gomphocerus transcaucasicus* is different from *G. sibiricus turcicus* by typical transversal sulcus distinctly curved (in *G. sibiricus turcicus* straight), cerci short and thick (in *G. sibiricus turcicus* long and thin) (Demirsoy 1977).

*Gomphocerus transcaucasicus* is different from *G. sibiricus hemipterus* Karabağ, 1953 by tegmina surpassing the tip of abdomen in male and reaching to its tip in female (in *G. sibiricus hemipterus* reaches to the end of 6th tergite in male and middle of second tergite in female) (Karabağ 1953).

The male calling song of *Gomhocerus transcaucasicus* is different from *G. sibiricus*. The differences are: syllables lasting 180–350 ms (in *G. sibiricus* 100 ms); at the end of the echeme, lower intensity syllables absent (in *G. sibiricus* present and duration of this second part greatly varies, from 2 to 11 s); a syllable consists of the two types

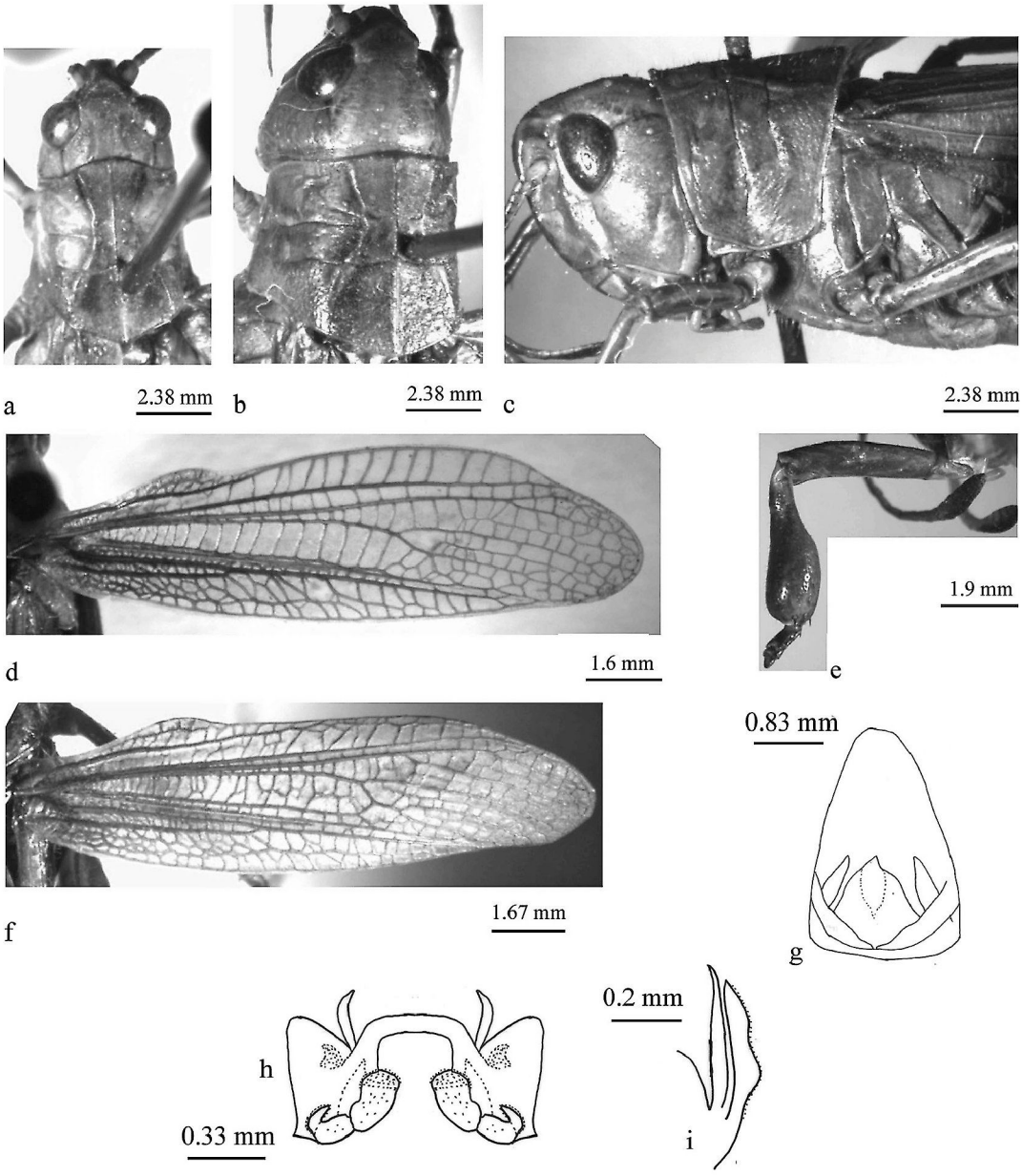


Fig. 2. *Gomphocerus transcaucasicus* **stat. n.** – a. Male head pronotum. – b. Female head pronotum. – c. Female head pronotum laterally. – d. Male tegmina. – e. Male front tibia. – f. Female tegmina. – g. Male supra-anal plate. – h. Epiphallus. – i. Penis.

of pulses: pulses of the higher amplitude repeated at higher rate alternate with the low-amplitude pulses repeated at lower rate. The pulses of the two types also differ in duration. Especially this quite interesting feature discriminate *G. transcaucasicus* from *G. sibiricus* [in *G. sibiricus*, syllables contain pulses of only one type, produced mainly by downstroke of the femora (Ragge & Reynolds 1998, Bukhvalova & Vedenina 1998)].

*Redescription.* Supplemental to the description by Mistshenko (1951) and Demirsoy (1977) based on new material. Head nearly as wide as

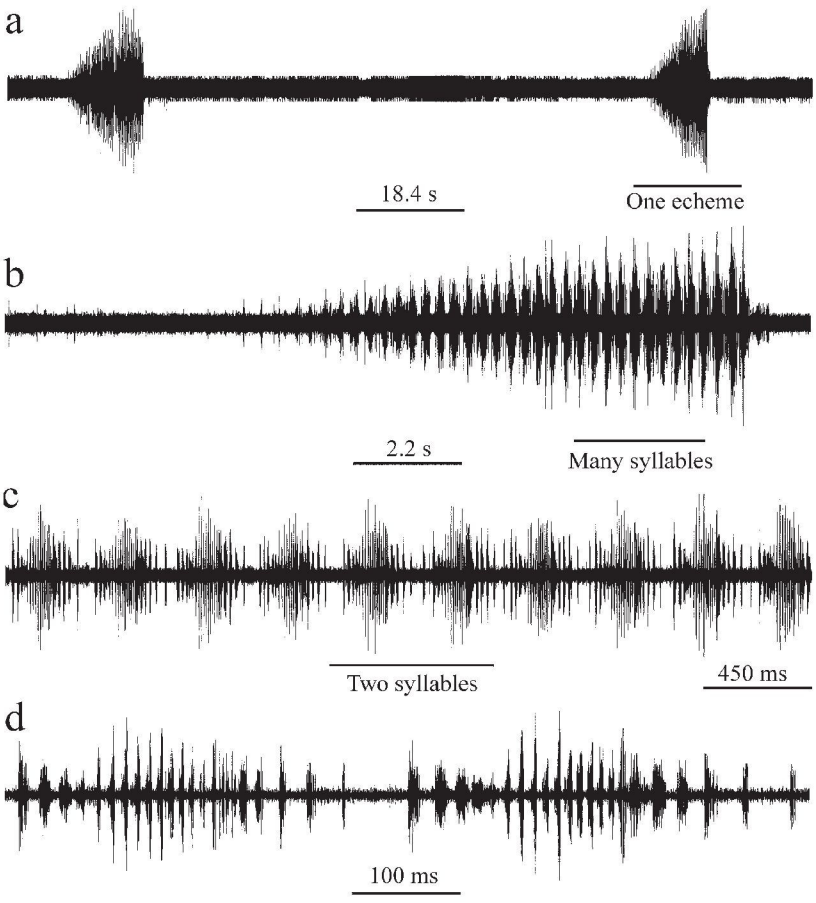


Fig. 3. *Gomhocerus transcaucasicus* **stat. n.** male calling song. – a. Echeme series with one echeme indicated. – b. One echeme with many syllables indicated. – c. Many syllables with two syllables indicated. – d. Two syllables.

pronotum in male (Fig. 2a), wider than pronotum in female. Frons smooth and narrow in front of fastigium, wide between antennas. Frontal keels distinct near ocellus, as rounded edges between antennae and disappear toward clypeus. Fastigium wide, generally with a median keel. Vertex hill-shaped, higher than eyes and generally with madian keel. Vertical diameter of eyes / minimum width of vertex between eyes 1.33–1.54 in male, 1.07–1.26 in female; ratio between vertical diameter of eyes / length of subocular groove 1.33–1.50 in male, 1–1.28 in female; length of faveolae 2.75–3.75 times as long as wide in both sexes. Longest medial segment of antennae 1.5–2.1 times as long as wide in male, 1.20–1.85 times in female.

Pronotum slightly constricted in middle, its frontal margin evidently convex in male, slightly convex in female, hind margin triangular in male, obtusely rounded in female; median keel distinct and entire, raised in both sexes; typical transversal sulcus located before middle, curved ventral ward, length of median keel before sulcus: after sulcus 1.27–1.58 in male, 1.05–1.27 in female (Fig. 2b). Lateral keels distinct and entire and bow shaped inward median keel, the maximum/minimum widths between lateral keels 2.44–2.71 in male, 2.5–2.9 in female.

Mesosternal interspace wide, its maximum length / maximum width 1.43–1.6 in male, 1.6–2 in female. Sternum and legs with sparse setae. Frontal tibia pear-shaped (Fig. 2e), its length / maximum width 3–3.5 in male; hind femur long, its length/maximum width 3.95–4.1 in male, 3.78–4.32 in female.

Tegmina surpass to tip of hind femur in male, almost reach to tip of abdomen in female, 3.30–3.36 times as long as wide in male (Fig. 2d), 3.5–4.27 in female; widening apicalward, its maximum width located around middle of distal half in

male and widely rounded apically; precostal area with a distinct false vein, not reaching to middle of tegmina; costal field wide, its maximum width 1.87–2.29 times wider than maximum width of subcostal field in male, 1.75–2.88 times in female (Fig. 2f). Subcostal and radial veins weakly sinuate. Medial vein with two branches near apex; medial field extends along proximal from 5.5 / 10 to 6.1 / 10 of the tegmen with a distinct false vein in female, its maximum width slightly wider than the maximum width of costal field, maximum width of medial field 3.5–6.5 times as wide as maximum width of first cubital field in female. Stigma located before apex and nearly cover 11 / 17 or 14 / 17 of tegmen. Alae as long as tegmina in both sexes.

Abdominal segments with long and sparse setae ventrally; tympanal opening semicircular, its medial height 2–2.5 times of its width in male, 2–2.3 in female. Anal tergum and subgenital plate with long sparse setae; cerci 1.87–2.23 times as long as wide in male, 1.1–1.91 in female (Fig. 2g). Two lobes of epifallus with a big anterior and a big posterior notch; its lateral lobes small (Fig. 2h). Apical valves of penis with saw-shaped outer edges, shorter than cingular valves and reach to inside of penis (Fig. 2i).

Coloration: In general appearance brownish green dorsally and yellowish-brown ventrally; tip of antennae blackish, frons from ocellus to clypeus black, vertex brown- greenish; pronotum dorsally brownish-yellow (Fig. 2c), lateral lobes of pronotum brown-greenish, tegmina brownish, hind femur green dorsally, yellow or brownish yellow ventrally; hind tibiae yellowish-brown.

Measurements (in mm; from 10 males and 10 females): Length of body male 14.5–17, female 19.7–22; pronotum male 3.9–4.4, female 3.8–4.8; tegmina male 12.7–13.2, female 12–14; hind femur male 9.4–10, female 10.8–11.

Song: Calling song consists of an echeme lasting 16.2–20 s and composed of about 30–60 syllables (Fig. 3a). The echeme begins quietly, gradually becoming louder (crescendo) and is reached often the first 20–25 syllables to maximum intensity (Fig. 3b). Each syllable lasts 180–350 ms and consists of 15–25 pulses (Fig. 3c). Oscillographic analysis shows that a syllable consists of the two types of pulses: pulses of the higher amplitude repeated at higher rate alternate with the low-amplitude pulses repeated at lower rate (Fig. 3d). The pulses of the two types also differ in duration.

*Distribution.* Azerbaijan: Naxçivan (Bey-Bienko & Mistshenko 1951), Turkey: Artvin; Erzurum; Rize; Trabzon (Karabağ 1958, 1963; Weidner 1969; Demirsoy 1975, 1977; Salman 1978). Herein first time recorded from Ardahan.

### 3.3. Genus *Aeropedellus* Hebard, 1935

*Aeropedellus turcicus* Karabağ, 1959 (Fig. 4a–h, Fig. 5a–b)

*Aeropedellus turcicus* Karabağ, 1959: 58–60, fig. 1–9, (holotype – male, Turkey: Trabzon, Zigana dagi; in British Museum (Natural History); other paratypes in the Zoological Institute, University of Ankara, not studied).

*Aeropedellus turcicus*: Weidner 1969: 206; Demirsoy 1977: 229; Çıplak and Demirsoy 1996: 245; Çıplak *et al.* 1999: 766; Otte *et al.* 2011.

*Material examined.* Trabzon: Ziğana Dağı, Gümüş Yaylası, 14.VIII.2004, 2,150 m a.s.l., 5 ♂, 27 ♀.

*Redescription.* Supplemental to the description by Karabağ (1959), based on new material from type locality. Head slightly narrower than pronotum in male (Fig. 4a), distinctly narrower than pronotum in female (Fig. 4b); vertical diameter of eye / minimum width of vertex between eyes 1.25–1.40 in male, 1–1.2 in female; vertical diameter of eye / length of subocular groove 1.4–1.65 in male, 1.13–1.5 in female, faveolae long, their margins curved, 2.6–3.5 times longer than wide in male, 2.5–3 times in female; longest medial segment of antennae 1.3–1.8 times longer than wide in both sexes (Fig. 4c); vertex with median keel in both sexes.

Pronotum slightly constricted in middle, its frontal margin weakly convex, its hind margin obtusely angular; third transversal sulcus straight or indistinctly curved, located before middle; length of median keel before sulcus / after sulcus 1.45–1.1.6 in male, 1.25–1.5 in female. Lateral keels well developed, the maximum / minimum widths between lateral keels 1.8–2.5 in male, 1.8–2.3 in female.

Mesosternal interspace wide, 1.2–1.45 times

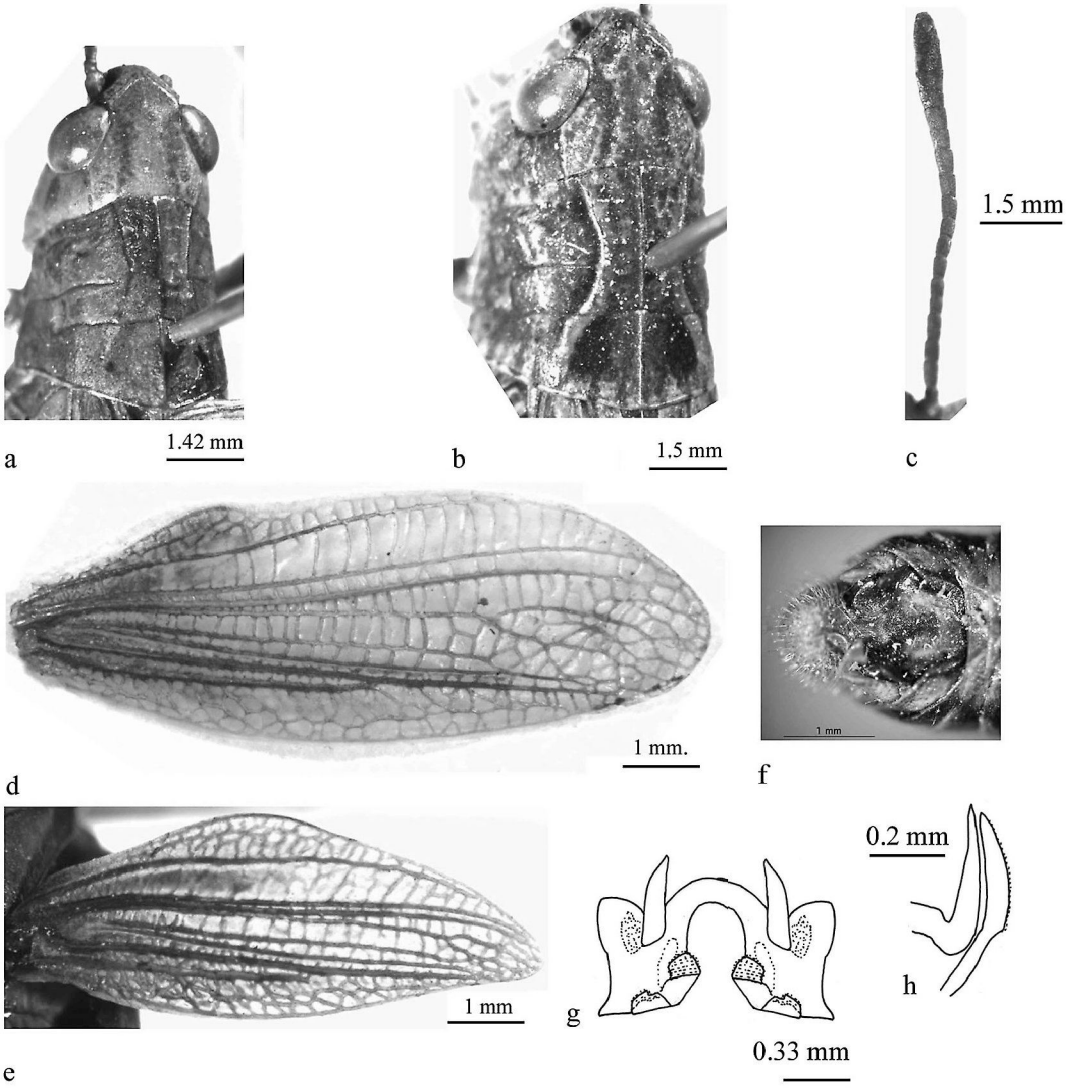


Fig. 4. *Aeropedellus turcicus*. – a. Male head pronotum. – b. Female head pronotum. – c. Male antenna. – d. Male tegmina. – e. Female tegmina. – f. Male supra-anal plate. – g. Epifallus. – h. Penis.

wider than long in male, 1.4–2 times in female; sternum and legs with sparse setae. Hind femur long, 3.8–4.2 times as long as its maximum width in both sexes.

Tegmina almost reach to tip of abdomen in male, reach to middle of 3rd or to middle of 4th of abdominal tergum in female, 2.7–3.2 times as long as wide in male, 2.2–2.7 times in female; in male narrowing gradually, in female abruptly in apicalward, the maximum width of tegmen is located middle of distal half in male, nearly in the middle in female; precostal field extends proximal half of tegmina, without a false vein in male (Fig. 4d); costal vein slightly sinuate, costal field reaches to apex, its maximum width 2.5–2.75 times as wide as maximum width of the subcostal field in male, 5–10 times in female (Fig. 4e); subcostal vein clearly sinuate, maximum width of subcostal area slightly narrow than medial field; medial vein mostly with two branches in apically, medial field extend along proximal 7 / 10–7.5 / 10 of tegmen in male, in general first and second cubital veins separate, stigma indistinct.

Abdominal segments with long and dense

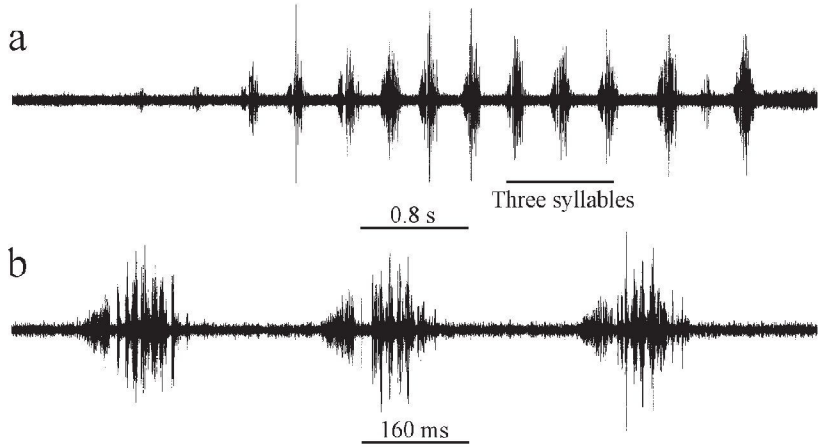


Fig. 5. *Aeropedellus turcicus* male calling song. – a. One echeme with three syllables indicated. – b. Three syllables.

setae especially ventrally (Fig. 4f); tympanal opening semicircular, 2.3–2.8 times as high as wide in middle in both sexes. Cerci 1.6–2.2 times wider in male, 1.8–2 in female, it reaches to apex of anal tergum in male, shorter in female; epiphallus with wide lateral lobes (Fig. 4g); apical valves of penis shorter than cingular valves (Fig. 4h).

Measurements (in mm; from 5 males and 15 females): Length of body male 15.5–17, female 19–22; pronotum male 3.5–4, female 4–4.7; tegmina male 9–10, female 6.2–7.1; hind femur male 9–10, female 11–11.5.

Song: Recorded from type locality, N 40°38.697' / E 39°24'.164', 17.VIII.2006, at 31 °C. Male calling song consists of an echemes lasting 3–6 s, composed of about 13–30 syllables and it lasts 100–180 ms (Fig. 5a). Each syllable consists of two different types of pulse. In each syllable, a low-amplitude pulse precedes a series of the short, dense and higher-amplitude pulses (Fig. 5b).

*Distribution.* Turkey: Trabzon (Karabağ 1959).

### 3.4. Genus *Dasyhippus* Uvarov, 1930

*Dasyhippus uvarovi* Karabağ, 1953 (Fig. 6a–j, Fig. 7a–c)

*Dasyhippus uvarovi* Karabağ, 1953: 190–191, figs. 50–52 (holotype – female, Turkey: Muğla province; in Collection of Biology department in Hacettepe University, Ankara-Turkey (HUZOM), not studied).

*Dasyhippus uvarovi:* Karabağ 1958: 147; Weidner 1969: 206; Demirsoy 1977: 228; Çıplak and Demirsoy 1996: 245; Çıplak *et al.* 1999: 766.

*Material examined.* Çankırı: Çankırı-Atkaracalar-Bolu yolu, 1,280 m a.s.l., 14.VII. 2005, 6 ♂, 5 ♀.

*Diagnosis.* Based on the previous study (Demirsoy, 1977) and examined material of *D. escalerai* (Bolivar, 1899) from Turkey Malatya: Doğanşehir, Çığlık, 1,200 m a.s.l., 28.V.1989, 3 ♂, 1 ♀; Arguvan, Morhamam köyü, 800 m a.s.l., 15.V.1988, 3 ♂; Arguvan, Kuyudere köyü, 1,300 m a.s.l., 27.VI.1988, 1 ♀ (Leg. B. Çıplak); deposited in Department of Biology, Zoological Museum, Antalya, Turkey (AUZM). *Dasyhippus uvarovi* can be easily distinguished from *D. escalerai* by following characteristics: tegmina 3.5–3.83 times as long as wide in male, 3.5–4 times in female (in *D. escalerai* 4.5–5 in male, 5.5 in female); tegmina acute in both sexes (in *D. escalerai* broad in both sexes), subcostal field wide apically in male (in *D. escalerai* not widened), tegmina reach to 5th–6th abdominal terga in female (in *D. escalerai* reach to tip of the abdomen); hind femur 4–4.2 times as long as its maximum width in male (in *D. escalerai* 4.6–5 times).

*Description.* Male: Head as wide as or slightly wider than pronotum (Fig. 6a); vertical diameter of eyes / minimum width of vertex between eyes 1.7–2; the ratio between vertical diameter of the eyes / length of subocular groove 1.65–2; faveolae long, their margins slightly curved, 2.5–3 times longer than wide; frontal

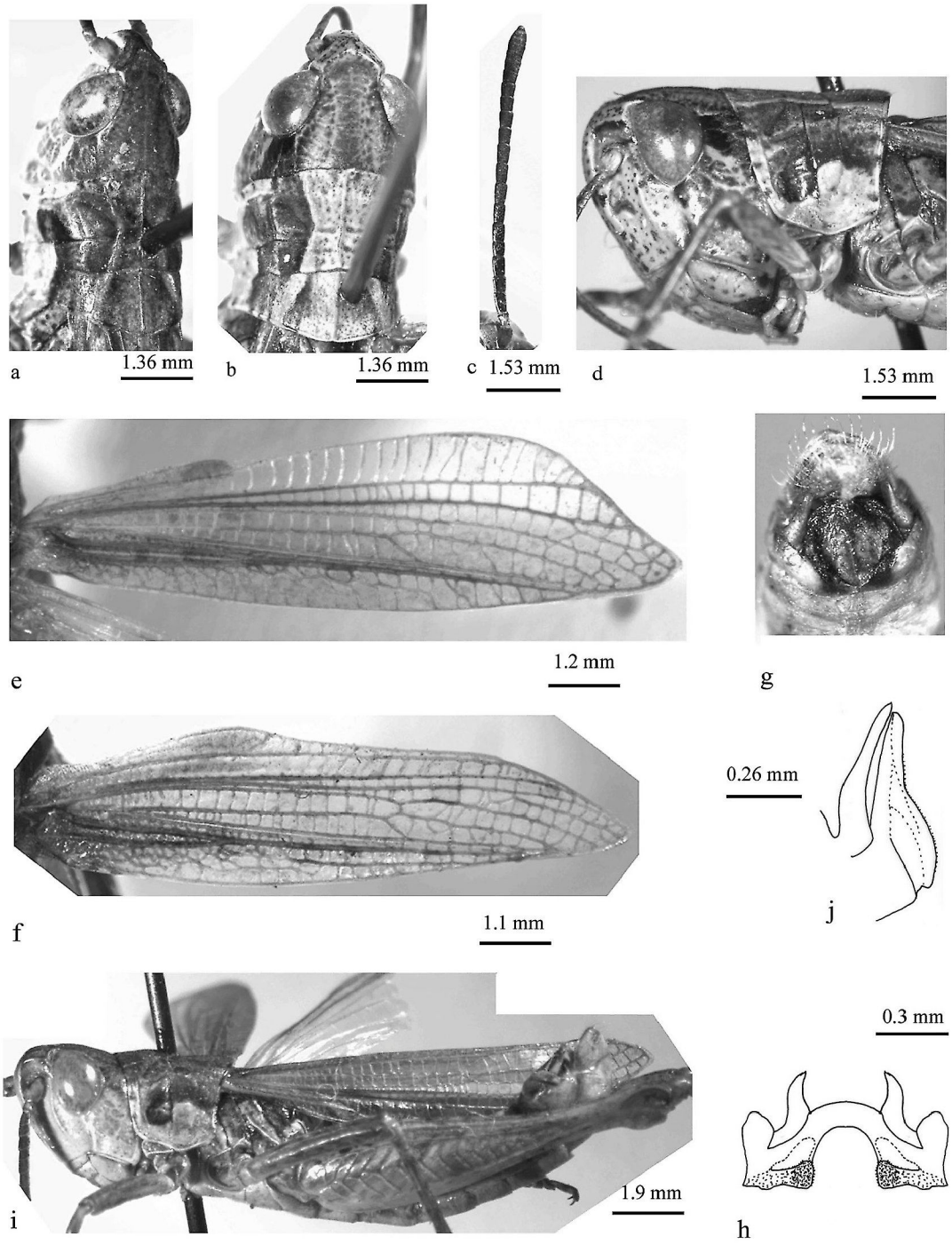


Fig. 6. *Dasyhippus uvarovi*. – a. Male head pronotum. – b. Female head pronotum. – c. Male antenna. – d. Female head pronotum laterally. – e. Male tegmina. – f. Female tegmina. – g. Male supra-anal plate. – h. Epiphallus. – i. Male laterally. – j. Penis.

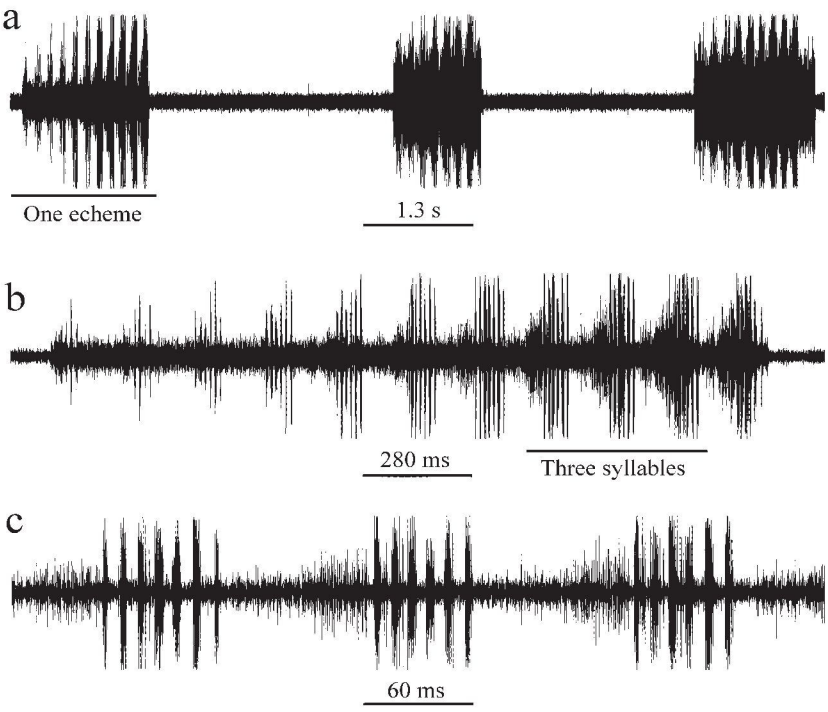


Fig. 7. *Dasyhippus uvarovi* male calling song. – a. Echeme series with one echeme indicated. – b. One echeme with three syllables indicated. – c. Three syllables.

carinae come close to one another below the ocellus, divergent toward clypeus; antennae extend beyond hind margin of pronotum, 1.6 times longer than combined length of head and pronotum, its longest medial segment 1.5–2 times longer than wide (Fig. 6c); fastigium without median keel, vertex frequently with median keel; head with sparse thin setae, especially ventrally.

Pronotum slightly constricted in the middle, its frontal margin weakly convex, its hind margin angular or obtuse angular; median keel distinct and entire, slightly high in profile. First and second lateral sulcus seldom cut lateral keels. Third transversal sulcus slightly curved, located before middle, length of median keel before / after sulcus 1.3–1.45. Lateral keels distinct and entire, rarely thicker in metazona; curved inward as a bow toward median keel, the maximum / minimum widths between lateral keels nearly 1.8–2.2. Lateral lobes of pronotum slightly higher than wide.

Mesosternal interspace almost equal length and width; margins of mesosternal lobes parallel or slightly divergent backward. Hind femur long, 4–4.2 times as long as its maximum width. Lower inner keel of hind femur with 168–174 stridulatory pegs.

Tegmina extend to tip of the abdomen, but not reaches to apex of the hind femur, 3.5–3.83 times wider (Fig. 6e) and narrows apicalward. Precostal area shorter than half of the tegmina, without a false vein, maximum width of precostal field almost half of the maximum width of costal field. Subcostal vein sinuates apicalward. Subcostal field reaches almost to tip of the tegmina and expands toward apex of the tegmina, its maximum width 1–1.3 times as wide as the maximum width of the radial field and 1.4–1.85 times as wide as the maximum width of the medial field. Costal field wide, its maximum width 1.4–1.5 times as wide as maximum width of the medial field. Medial vein mostly divided into two branches; medial field longer than half of the tegmen, its maximum width 0.76–1 times wider than the greatest width of the first cubital field. First and second cubital veins separate. Stigma absent. Alae slightly shorter than tegmina.

Abdomen. Subgenital plate with long and dense setae. Tympanal opening semicircular, 1.5–1.8 times wider in the middle. Cerci 2–2.25 times wider and surpass apex of anal tergum (Fig. 6g). Two lobes of epiphallus with big anterior and posterior notches (Fig. 6h), its lateral lobes small.

Apical valves of penis with saw-shaped outer edges which shorter than cingular valves of penis (Fig. 6j).

*Redescription of female.* Supplemental to the description by Karabağ (1953), based on new material. Head as in male, vertical diameter of eyes / minimum width of vertex between eyes 1.5–1.75, ratio between vertical diameter of eyes / length of subocular groove 1.37–1.53 (Fig. 6d); faveolae long, 2.5–3.2 times longer than wide; antennae shorter than combined length of head and pronotum, and its longest medial segment 1.2–1.85 times longer than width; vertex generally with median carina and higher than eyes.

Pronotum as in male, length of median keel before sulcus / after sulcus 1.23–1.45; maximum / minimum widths between lateral keels 2–2.25 (Fig. 6b); mesosternal interspace narrow, 1–0.75 times as wide as length. Hind femur long, its length 3.75–4.56 times of its maximum width.

Tegmina overlap dorsal and reach to 5th–6th abdominal terga, 3.5–4 times as long as width. Precostal field reaches almost to end of proximal 7–8 / 10 of tegmen, with a false vein, its maximum width 1.2–1.6 times wider than maximum width of median field. Maximum width of costal field 1.6–2 times wider than maximum width of subcostal field. Medial vein with two branches near apex; medial field extends proximal from 5.5 / 10 to 6.5 / 10 of the tegmen, first and second cubital veins separate; first cubital field almost as wide as medial field in their maximal widths. Stigma located in 12 / 17–14 / 17 of tegmina (Fig. 6f).

Abdomen. Tympanal opening semicircular, 1.8–2 times as high as wide in middle. Cerci 1.5–2 times as long as wide and shorter than anal tergum.

Coloration, male and female. In general appearance brown or dirty brown with blackish pattern dorsally and yellowish brown ventrally (Fig. 6i); head and disk of pronotum dirty brown in male and yellowish in female, other parts dirty yellowish around lateral keels or blackish along light lateral keels in both sexes. Tegmina almost brownish in both sexes, with the exception of costal and subcostal field; hind knee brownish dorsal and yellowish ventral, hind tibiae yellowish.

Measurements (mm), 5 males and 5 females: Length of body male 16–17.5, female 19–22; pronotum male 3–3.3, female 3.2–3.8; tegmina male 10–11, female 7.8–10; hind femur male 9.5–10, female 10–12.8.

Song. Recorded from Turkey, Çankırı: Çankırı-Atkaracalar-Bolu yolu, 1,280 m a.s.l., 14.VII.2005, at 32 °C. The calling song consists of echeme series, repeated with intervals of about 2–4 s and containing 2–5 echemes beginning quietly but rapidly reaching maximum intensity (Fig. 7a). Each echeme lasts 1–1.5 s. The echeme consists of 6–11 repeated syllables lasting 60–150 ms (Fig. 7b). After middle of the echeme, each syllable consists of unpulsed and pulsed sound parts (Fig. 7c).

Previous records: Muğla: Merkez, 1.VII. 1945, 2 ♀ (Karabağ 1953).

*Distribution.* Endemic to Turkey.

## 4. Conclusions

In this study, a new species of *Eremippus* is described. This new species, *E. zeybekoglui* **sp. n.**, is easily distinguished from other species of *Eremippus* known in Anatolia, but the species has some similarities with *E. angulatus* Uvarov, 1934. It differs from it by the characters noted in diagnoses. Thus, according to the species list by Çıplak *et al.* (1999) and to my studies, six species are known in Turkey. These species are *E. simplex* (Eversmann 1859), *E. angulatus* Uvarov, 1934; *E. gracilis* Uvarov, 1934, *E. turcicus* Ramme, 1951; *E. weidneri* Demirsoy, 1977, and *E. zeybekoglui* **sp. n.**

There are three species of the genus *Gomphocerus* in Anatolia, one of which is divided into three subspecies: *Gomphocerus transcaucasicus* Mistshenko, 1951; *G. armeniacus dimorphus* Karabağ, 1953, *G. sibiricus turcicus* Mistshenko, 1951; *G. s. hemipterus* Karabağ, 1953, and *G. s. acutus* Karabağ, 1957. All these taxa need further revision.

*Aeropedellus turcicus* was described by Karabağ (1959). Since then, this endemic species is rarely mentioned in literature, mainly only in faunistic lists (Weidner 1969, Demirsoy 1977, Çıplak & Demirsoy 1996b, Çıplak *et al.* 1999). In this study, the male and female morphology of *A. turcicus* is redescribed and the description of the male calling song is presented.

In the previous studies (Demirsoy 1977, Çıplak *et al.* 1999), two species of *Dasyhippus* were recorded in Anatolia: *Dasyhippus escaleari* (Bolivar, 1899) and *Dasyhippus uvarovi* Karabağ, 1953, which are endemic for Anatolia. Until this study, the male of *D. uvarovi* was not known. In this study, its male morphology and calling songs are presented for the first time and the female body shape is redescribed by using new materials.

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