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Gryllofulvius gibbosus Taszakowski gen. et sp. nov. – a remarkable, flightless and stridulating plant bug (Heteroptera: Miridae: Cylapinae) from Madagascar

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Abstract. *Gryllofulvius* Taszakowski gen. nov., a new remarkable genus of the subfamily Cylapinae, tribe Fulviini, is described from Madagascar. The new species *Gryllofulvius gibbosus* Taszakowski gen. et sp. nov. is documented with photographic images, SEM micrographs of the selected body parts, and female genitalic structures. The stridulatory device (embolial stridulitrum and metafemoral plectra) of the new taxon is described, and the stridulation in Cylapinae is discussed.

Keywords. Afrotropical region, entomology, Fulviini, Hemiptera, plant bugs, true bugs.

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Introduction

Madagascar is one of the top biodiversity hotspots on the Earth (Fritz-Vietta *et al.* 2011). However, only 95 species of Miridae Hahn, 1833 (plant bugs) have so far been recorded from Madagascar (Masłowski *et al.* 2023). Sixty-seven species (71%) are endemic to this island (Masłowski *et al.* 2023).

Plant bug subfamily Cylapinae Kirkaldy, 1903 , including nearly 530 species, is currently recognized as one of the least diverse plant bug subfamilies (Cassis & Schuh 2012; Wolski *et al.* 2023; Namyatova & Tyts 2025). They have recently been extensively addressed (e.g., Wolski *et al.* 2020, 2023; Namyatova & Cassis 2021, 2022; Wolski 2021; Tyts *et al.* 2022; Namyatova & Tyts 2025), which resulted in a significant increase in our knowledge of the diversity, distribution and morphology of the subfamily.

The Madagascan fauna of Cylapinae is represented by 12 species belonging to seven genera (Poppius 1909; Carvalho 1952, 1981; Gorczyca 1996, 1998a, 2000, Taszakowski *et al.* 2022; Masłowski *et al.* 2023). Herein, we describe a remarkable new genus and species from Madagascar. Photographs of the female habitus and genitalia and scanning electron micrographs of the selected structures, including the stridulatory device, are provided.

Material and methods

The photographs of the type specimen were taken at the Laboratory of Insect Anatomy and Morphology, Institute of Biology, Biotechnology and Environmental Protection, the University of Silesia in Katowice (Katowice, Poland) as follows: the focus-stacked, colour photographs were prepared with a Leica M205C stereo microscope with a high diffuse dome illumination Leica LED5000 HDI, Leica Flexacam C3 digital camera, and LasX ver. 5.1.025593 software (Leica Microsystems, Vienna, Austria). SEM micrographs were prepared in the Educational Laboratory of Scanning Microscopy, Institute of Biology, Biotechnology and Environmental Protection, the University of Silesia in Katowice (Katowice, Poland) using Phenom XL scanning electron microscope (Phenom-World B.V., Eindhoven, The Netherlands) at 15 kV accelerating voltage with a BackScatter Detector (BSD). To obtain high-quality figures, fragments of specimens (for both light microscopy and SEM) were imaged at high magnifications. Then photographs were combined using the Image Composite Editor (panoramic image stitcher). The figures were prepared using Adobe Photoshop CS6 graphic editor. Images of the female genitalia were taken in the Laboratory of Insect Systematics and Ecology, Institute of Biology, University of Opole (Opole, Poland) using an Olympus BX upright light microscope with a Canon EOS 750D digital camera. Multiple image layers were stacked using Helicon Focus ver. 7.6.1 software. The female abdomen was macerated in a 10% solution of KOH for 24 hours (room temperature) and stained with chlorazol black. Adult terminology used in the text follows Schuh & Weirauch (2020). Terminology of female genitalia follows Davis (1955), Pluot-Sigwalt & Matocq (2017) and Schuh & Weirauch (2020).

Measurements were made with LasX ver. 5.1.025593 software and are given in millimetres (mm).

The map was prepared in SAGA GIS 7.8.2 (Conrad *et al.* 2015; SAGA Development Team 2023; http://www.saga-gis.org using WGS84 datum and EPSG: 3395 (World Mercator cylindrical projection)).

Detailed label data are cited for the type material. The backward slash (\) separates the rows on the label.

The holotype is deposited in the Zdeněk Jindra collection (ZJC) currently deposited at the Department of Plant Protection, Czech University of Life Sciences, Prague, Czech Republic.

Results

Taxonomy

Class Insecta Linnaeus, 1758
Order Hemiptera Linnaeus, 1758
Suborder Heteroptera Latreille, 1810
Family Miridae Hahn, 1833
Subfamily Cylapinae Kirkaldy, 1903
Tribe Fulviini Uhler, 1886

Genus ***Gryllofulvius*** Taszakowski gen. nov.
urn:lsid:zoobank.org:act:ABEB03B2-A90F-4854-BEFE-163B99A02653

Type species

Gryllofulvius gibbosus Taszakowski gen. et sp. nov., here designated.

Diagnosis

Distinguished by small eyes, in female 0.14 × as width, and 0.3 × as long as head width, body glabrous and shiny, brachypterous; pronotal collar distinct, posterior angles of pronotum almost right; pretarsal claw with subapical tooth; hemelytra basally fused with each other and with the scutellum and mesoscutum and vertical hypocostal lamina developed as elongated stridulitrum.

Etymology

The genus name is created from a combination of '*Gryllus*', in reference to the cricket, and '*Fulvius*', the type genus of the tribe Fulviini Uhler, 1886, in which the new genus is placed. Gender: masculine.

Description

Body. In the shape of an elongated pear, length 3.1 mm; brachypterous (Fig. 1).

Texture and vestiture. Body almost hairless; head, pronotum, thoracic pleura, mesoscutum, scutellum and basal part of hemelytron with isolated, scattered setae (Fig. 2A–F); femora with few setae, tibiae and tarsi with relatively dense setae (Fig. 2J). Body glabrous and shiny (Fig. 1A–B) except wrinkled pronotal collar (Fig. 2C), mesoscutum, base, middle and apical part of scutellum and base of hemelytra (Fig. 2D). Relatively vertical hypocostal lamina with developed elongated stridulitrum (Fig. 2F, H). Central part of inner metafemoral surface with numerous minute bumps forming plectrum (Fig. 2G, I).

Structure. Head. Eyes small, removed from pronotal collar (Figs 1, 2A); vertex strongly convex; scape nearly cylindrical; labium reaching hind coxae; segment I subdivided in distal part.

Thorax. Pronotum almost square, pronotal collar distinct, anterior angles rounded, anterior lobe strongly convex, large, occupying almost whole pronotum (Figs 1B–C, 2A–B); anterior margin strongly rounded, posterior margin straight, sides rounded in posterior part. Mesoscutum and scutellum: Mesoscutum flat; scutellum slightly concave (Figs 1B–C, 2A). Thoracic pleura: Scent gland evaporative area of metepisternum narrow. Hemelytron: brachypterous, narrow on basal half, flaring wider apically; strongly depressed across basal part, strongly convex in remaining part. Hemelytra basally fused with each other and with scutellum and mesoscutum; claval suture shortened, thickened and raised; clavus and corium partially fussing, cuneal fracture absent, apex rounded, apical margin cutting inward forming V with both hemelytra together; apical three abdominal segments exposed beyond hemelytra.

Legs. Tarsus three-segmented (Fig. 2J); pretarsal claw with subapical tooth.

Abdomen. Female genitalia: genital chamber membranous (Fig. 3A–B); sclerotized rings paired, relatively large, subellipsoid; ovipositor thin; gonapophyses 8 connected by distinct membranous structure along entire length (Fig. 3B, E); apices of gonapophyses 8 and 9 obtuse, without any teeth apically (Fig. 3F–G).

Gryllofulvius gibbosus Taszakowski gen. et sp. nov.
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Figs 1–3

Diagnosis

See the generic diagnosis.

Etymology

Adjective derived from Latin '*gibbosus*' – 'humped'.

Type material

Holotype

MADAGASCAR • ♀; Toliara Province; 1400–1670 m a.s.l.; 17–23 Dec. 1988; P. Bulirsch leg.; "E Madagascar17.-23.12.1988 \ 30kmSEE of Betroka, 1400- \ 1670m, Vohitrosa forest,2km \ E of ▲1825m, P.Bulirsch lgt."; ZJC.

Description

Female

As in generic description. Dorsum generally brown (Fig. 1A–B).

Head. Brown; scape dark brown (pedicel and flagellum missing); labium brown.

Thorax. Pronotum dark brown. Mesoscutum dark brown, lighter in anterior part. Scutellum dark brown. Thoracic pleura dark brown. Metathoracic scent glands ivory. Hemelytron: Inner margin and posterior margin brown, remaining surface dark brown.

Legs. Brown to dark brown, tarsi light brown.

Abdomen. Mostly dark brown.

Measurements. Body: length 3.1, width 1.2. Head: length 0.73, width including compound eyes 0.56, interocular distance 0.40, eye dorsal width 0.08, eye dorsal length 0.17. Antenna: length of scape 0.29 (antennomeres II–IV missing). Length of labial segments: I 0.57, II 0.63, III 0.63, IV 0.40. Pronotum: length 0.45, width of posterior margin 0.52.

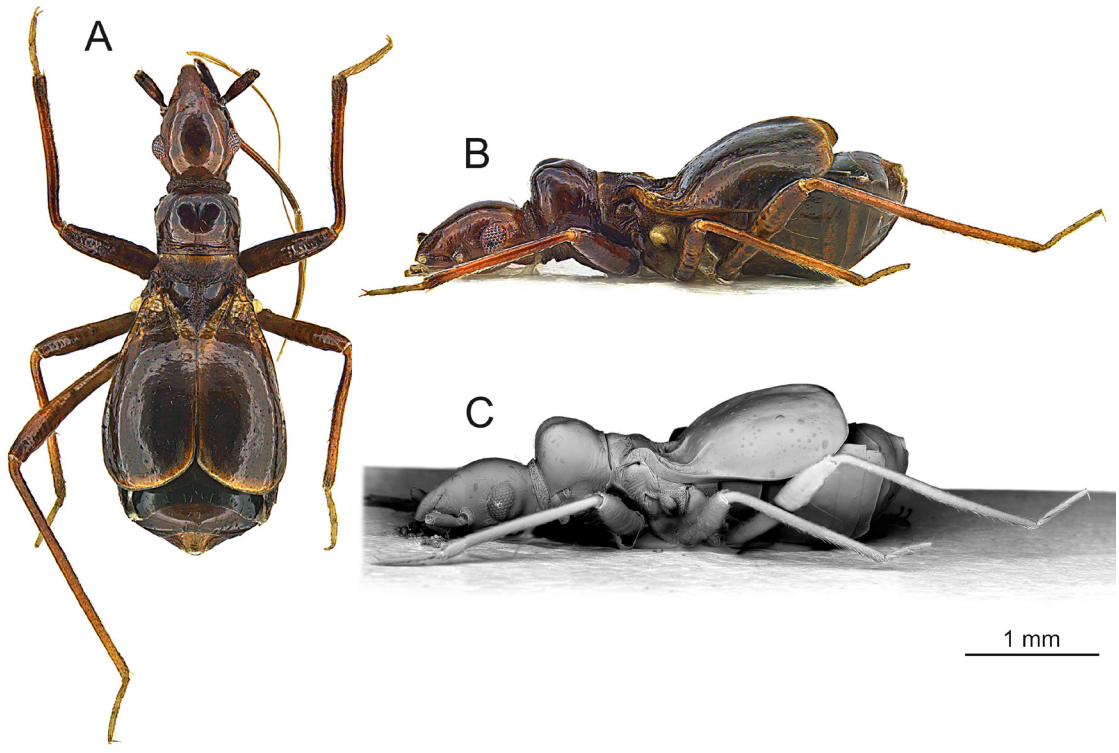

Fig. 1. *Gryllofulvius gibbosus* Taszakowski gen. et sp. nov., holotype, ♀ (ZJC). **A**. Dorsal view. **B–C**. Lateral views.

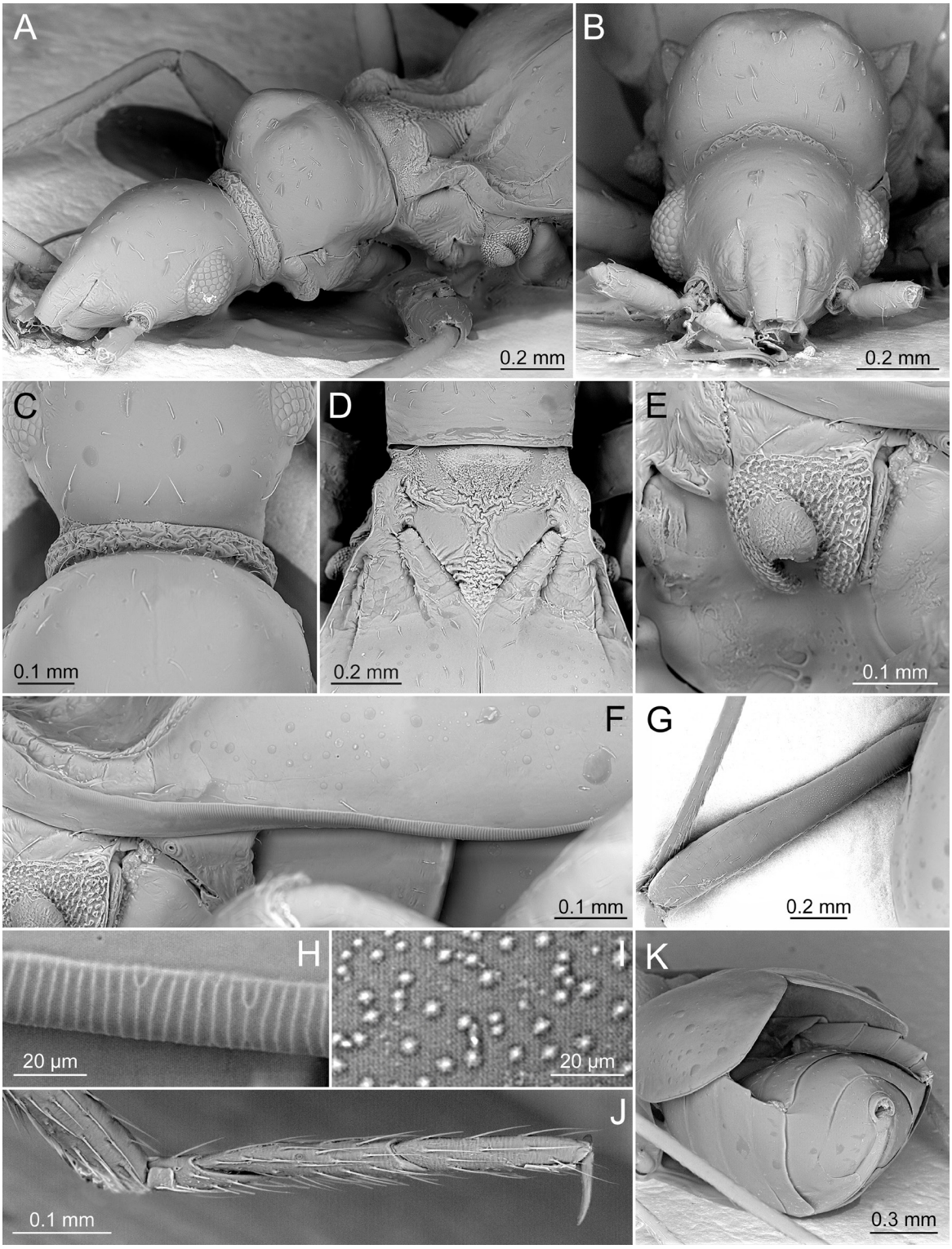

Fig. 2. *Gryllofulvius gibbosus* Taszakowski gen. et sp. nov., holotype, ♀ (ZJC). **A**. Head and thorax, dorso-antero-lateral view. **B**. Head and pronotum, anterior view. **C**. Posterior part of head, pronotal collar and anterior lobe of pronotum. **D**. Posterior lobe of pronotum, mesoscutum, scutellum and base of hemelytra. **E**. Metathoracic scent gland efferent system. **F**. Stridulitrum on hypocostal lamina. **G**. Metafemur with plectrum. **H**. Magnified view of stridulitrum. **I**. Magnified view of plectrum. **J**. Metatarsus. **K**. Abdomen, posterior-lateral view.

Male

Unknown.

Biology

Unknown.

Distribution

S Madagascar.

Discussion

Systematic position

Gryllofulvius gen. nov. may undoubtedly be classified into the Cylapinae based on the characters of the tarsus and pretarsus, i.e. slender tarsi, absence of pulvilli, setiform parempodia, simple claw with the subapical tooth, and three rows of tiles on the unguitractor with those in the middle row acute. Possession of the simple, widely membranous genital chamber and posterior wall also warrants placement of the new taxon in the subfamily Cylapinae (Schuh & Weirauch 2020; Wolski 2021; Namyatova & Tyts 2025).

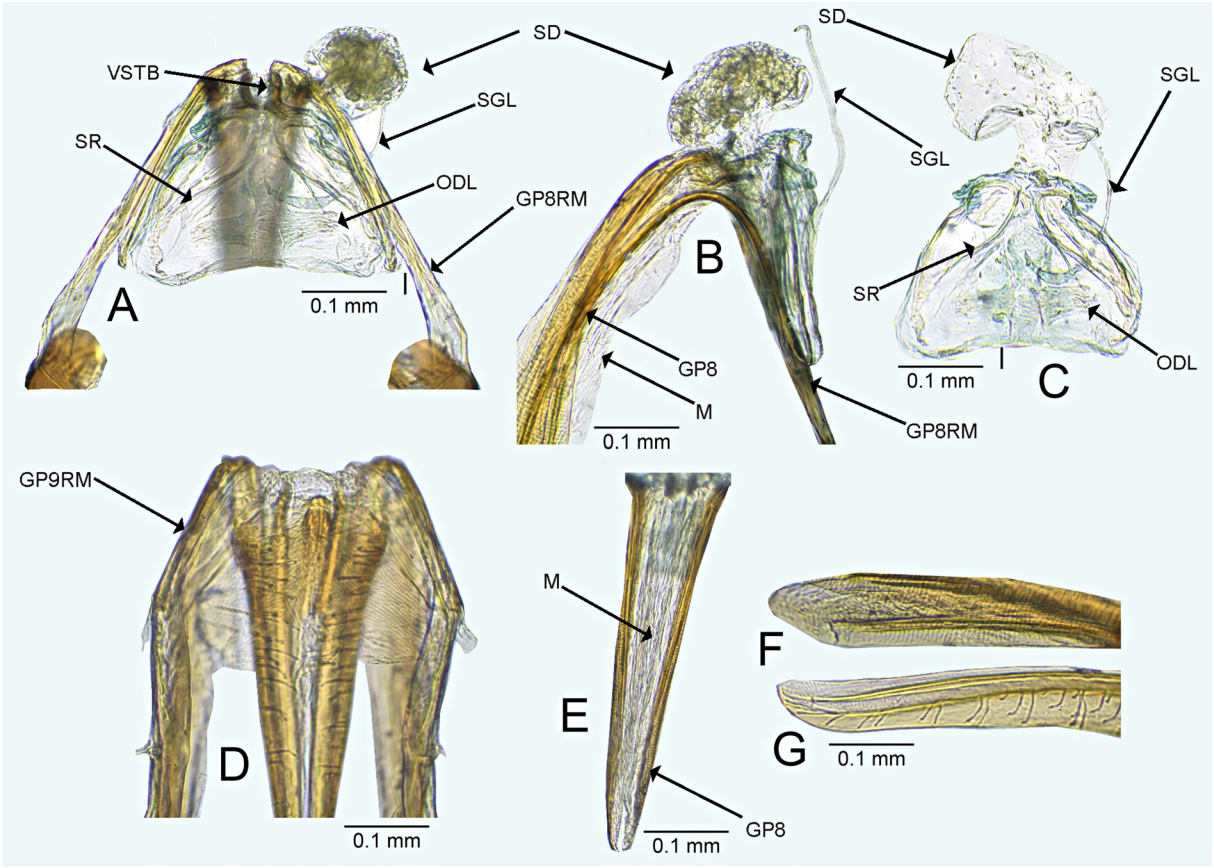

Fig. 3. *Gryllofulvius gibbosus* Taszakowski gen. et sp. nov., holotype, ♀ (ZJC), genitalia. **A**. Bursa copulatrix, dorsal view. **B**. Bursa copulatrix, lateral view. **C–D**. Bursa copulatrix, posterior wall. **E–G**. Ovipositor. **E**. Gonapophyses 8. **F**. Apex of gonapophysis 8. **G**. Gonapophysis 9. Abbreviations: GP8 = gonapophysis 8; GP8RM = ramus of gonapophysis 8; GP9RM = ramus of gonapophysis 9; M = membranous structure connecting gonapophyses 8; ODL = lateral oviducts; SD = seminal depository; SGL = spermathecal gland; SR = sclerotized rings; VSTB = vestibulum.

Gryllofulvius gen. nov. possesses the following characters presented by Gorczyca (2000) as diagnostic features for the Fulviini, i.e., porrect head; thin and long labium, reaching at least beyond base of metafemora; forecoxae and forefemora enlarged. It also has a set of characters that are commonly found in the tribe in its current concept, such as labial segments I subdivided; clypeal base situated above antennal insertions and ventral margin of eye; antennal insertion contiguous with sulcus between maxillary and mandibular plates; mandibular plate without sulcus posteriorly; bursa copulatrix relatively thin, not reaching laterally beyond rami of the first valvulae (Namyatova & Cassis 2019, 2021, 2022; Wolski 2021; Namyatova & Tyts 2025). Therefore, *Gryllofulvius* can be included in the tribe Fulviini.

The present new genus is distinctive and readily separated from any other genera of the subfamily by the set of features mentioned in the diagnosis. *Gryllofulvius* gen. nov. is somewhat similar to other representatives of Fulviini characterised by modified wings, such as the Australian *Fulvioaustrus monteithi* Carvalho, 1991 and the Afrotropical *Hemiophthalmocoris micropterus* Gorczyca, 2000, *Rhinofulvius albifrons* Reuter, 1895 and *Schmitzofulvius bigibber* Gorczyca, 1998 (Reuter 1895; Carvalho 1991; Gorczyca 1998a, 2000; Namyatova & Cassis 2022; Masłowski *et al.* 2023). The similarity, however, is superficial, and it is easy to distinguish *Gryllofulvius* from these species. Unlike *Gryllofulvius*, these taxa do not have such small compound eyes, almost right posterior angles of the pronotum, hemelytra basally fused with each other and with the scutellum and mesoscutum. In addition, they do not have recognizable stridulatory devices. The monotypic genus *Fulvioastrus* Carvalho, 1991 is also distinguished by having a slightly shortened, staphylinoid hemelytron and faintly demarcated calli (Namyatova & Cassis 2022). The characteristic feature of *Hemiophthalmocoris* Poppius, 1912 is the pretarsal claw devoid of the subapical tooth but having strongly developed, acute basal process, that is not found in any other representative of Cylapinae. Similar to *Fulvioastrus,* the monotypic genus *Rhinofulvius* Reuter, 1902 has a staphylinoid hemelytron. It also differs from *Gryllofulvius* by the lack of a pronotal collar and by having two-segmented tarsus (Gorczyca 2000). The genus *Schmitzofulvius* Gorczyca, 1998 differs from the new genus by its head with a transverse depression behind the eyes and with a moderately developed longitudinal sulcus between the eyes, both forming T-shaped furrow, as well as by the pretarsal claw without the subapical tooth (Gorczyca 1998a, 2000; Masłowski *et al.* 2023).

Stridulatory device

The elongated stridulitrum is developed on the relatively vertical hypocostal lamina (= hypocostal ridge, outer edge of costal margin, epipleura of the corium) (Fig. 2F, H). The plectrum is formed by numerous minute bumps on the median part of the dorsal surface of the metafemur (Fig. G, I). Stridulatory vibroacoustic signalling has evolved independently many times in Heteroptera, including plant bugs (Davranoglou *et al.* 2023). In Miridae, the stridulatory organs usually consist of the stridulitrum located on the wing edge or sternites of the abdomen and the plectrum located on the metafemur (Davranoglou *et al.* 2023). Such a mechanism evolved in Deraeocorinae Douglas & Scott, 1865 (Akingbohungbe 1979), Orthotylinae van Duzee, 1916 (Henry 2015), Phylinae Douglas & Scott, 1865 (Schuh 1974, 1984; Yasunaga *et al.* 2019; Tamada *et al.* 2020) as well as Cylapinae (Carvalho 1980; Gorczyca 1998a, 1998b, 1999, 2000, 2004; Yasunaga, pers. comm.). However, our research on representatives of the genera of Cylapinae that were believed to have a stridulatory device (*Euchilofulvius* Poppius, 1909, *Samoafulvius* Gorczyca, 2004 and *Schmitzofulvius* Gorczyca, 1998) did not confirm its presence. Tubercles located on the hypocostal lamina of representatives of the genera mentioned above (Carvalho 1980; Gorczyca 1998a, 1998b, 1999, 2000, 2004), in fact, are bases of the scaly setae. The lack of a stridulation mechanism is also confirmed by the absence of any structures on the metafemur that could act as stridulitrum/plectrum. Thus, the only representatives of Cylapinae that undoubtedly have a stridulatory device are species of the genus *Mimofulvius* Schmitz, 1978 (Yasunaga, pers. comm.). It appears that in *Gryllofulvius gibbosus* gen. et sp. nov., the sound produced by rubbing the metafemur against the hypocostal lamina may be amplified by the specific structure of the wings. The shortened,

partially fused and strongly convex hemelytra create some space above the abdomen (Fig. 2K), which may constitute a resonating tube. The morphology of *G. gibbosus* is surprisingly similar to the females of another stridulating species of the genus *Pilophoropsidea* Henry, 2015, e.g., *Pilophoropsidea camela* (Knight, 1930), belonging to Orthotylinae (Henry 2015). The similarities include the strongly convex pronotum, the shortened and raised hemelytra, and the structure of the stridulitrum (Henry 2015: figs 53–54, 116–119). Unfortunately, the plectrum has not been described in *P. camela*.

Wing modifications

Wolski & Gorczyca (2014) and Namyatova & Cassis (2019) discussed wing modifications in Cylapinae. Moreover, Masłowski *et al.* (2023) described a brachypterous female of *Schmitzofulvius bigibber*. In total, 30 species from the subfamily, including nine genera and 13 species of the Fulviini, have shortened wings. However, *Gryllofulvius gibbosus* gen. et sp. nov. is clearly distinguished from other representatives of the Fulviini with shortened wings by the fusion of the bases of the hemelytra with the scutellum and mesoscutum (Fig. 2A, D). Together with the thickened and raised claval suture (Fig. 2A), this feature stiffens the hemelytra, which may support its functioning as a resonating tube, as we have mentioned earlier.

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