



Descriptions of two new genera and six new species of ghost-moths (Lepidoptera: Hepialoidea: Hepialidae) from south-eastern and southern Brazil

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Abstract

Agripialus gen. n. and *Mutipialus* gen. n. are described to accommodate the following species: *A. campos* sp. n., *A. variabilis* sp. n., *A. itatiaia* sp. n., *A. caparao* sp. n., *M. dilatus* sp. n., and *M. monticolus* sp. n. All are from southeastern and southern Brazil. Diagnostic characters suggest a closer phylogenetic relationship between these two genera, than to any other described genus.

Key words: *Agripialus*, morphology, *Mutipialus*, Neotropical, taxonomy

Introduction

Since Nielsen *et al.* (2000) published their world catalogue listing 17 genera and 132 species for the Neotropics, there has been a considerable evolution of the taxonomic knowledge for this region. For example, in a review of this catalogue, Mielke & Grehan (2012) concluded that all subgenera of *Cibyra* Walker, 1856 should be reinstated to the status of full genera due to their distinct morphological characters. Grehan (2012) grouped 22 genera within the ‘cibyrene’ clade that is supported by strong morphological evidence for monophyly, based on characters of the tergo-sternal sclerite and wing venation (Mielke *et al.* 2019), although relationships within these genera have remained largely unresolved. This systematic and taxonomic clarification was followed by the addition of many new taxa, now totalling 28 genera and 150 species for Central and South America (Mielke & Grehan 2015, 2016b; Grehan & Rawlins 2016; Mielke *et al.* 2017; Mielke & Grehan 2017; Grehan & Mielke 2018; Mielke & Grehan 2019; Mielke *et al.* 2019; Mielke *et al.* 2020).

This generic diversity, representing over 50% of Hepialidae worldwide, characterizes a region extending between central Mexico to Tierra del Fuego in Argentina and Chile. As stated by Mielke *et al.* (2019), this high generic ratio reflects the morphological diversity within the group, especially for male genitalia.

In this article, we describe two new genera and six new species for a group of similar taxa that have not previously come to attention in the literature. We also discuss their putative relationships with other South American and world groups.

Material and methods

Terminology follows Kristensen (2003) for wing venation and female genitalia, Mielke & Casagrande (2013) with reference to the tegumen (= intermediate plate), saccus (= vinculum), and futura inferior (= juxta), Grehan & Mielke (2018) for the futura superior (= trulleum), Grehan & Mielke (2017) for the tergo-sternal sclerite, and Dumbleton (1966) for wing venation in the Hepialidae where ‘hepialine’ refers to the separate bifurcation of Rs1+Rs2 and Rs3 + Rs4.

Macerated structures were removed and heated in a solution of 10% KOH for about 10 minutes. The abdominal integument was opened by a right lateral cut from the tergosternal bar to the genitalia which was then removed and stained in Chlorazol black or violet gentian. Dissections were conserved in microvials with glycerol, and housed along with the specimens. Images of adults were made with a Panasonic digital camera DMZ-F250. The same camera was used for the genitalia with the addition of an attached Raynox Macroscopic ring lens Model M-250. All images were edited using Gimp 2.8, especially for genitalia where photographic contrast was improved to compensate for overexposure. Wing venation diagrams were drawn over photographic images using InkScape® software and Gimp 2.8, and supplemented by examination of specimens.

The presentation sequence of genera and species follows the morphological similarities found among them. The labels of all name-bearing types are given verbatim.

Abbreviations of collections

CEIOC	Entomological Collection of Oswaldo Cruz Institute, Rio de Janeiro, Rio de Janeiro, Brazil
CGCM	Collection Carlos G. C. Mielke, Curitiba, Paraná, Brazil
DZUP	Collection Padre Jesus S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil
MGCL	McGuire Center for Lepidoptera & Biodiversity, Gainesville, Florida, USA
MZSP	Museu de Zoologia, São Paulo, São Paulo, Brazil

Further abbreviations: HT (holotype), PT (paratype).

Taxonomic acts

Agripialus gen. n.

(Figs 1–7, 20–23, 25–26, 29, 31–33, 36–37, 40, 43–44, 47–48, 51–53)

Type species: *Agripialus itatiaia* sp. nov., by present designation.

Included species: *A. campos* sp. nov., *A. caparao* sp. nov., *A. itatiaia* sp. nov., and *A. variabilis* sp. nov.

Diagnosis. Distinguished from all other Hepialidae by (i) sternite VII in males (when known) forming two distinct plates (Figs 43–44), (ii) pseudotegumen partially membranous (Figs 47–48) and (iii) the lamella antevaginalis W-shaped and not connected to tergum IX (Figs 51–53). Also by the following combination of characters: i) transverse tuft over the eyes emerging just below the antennal socket, ii) labial palpus trisegmented, iii) antenna lamellate, iv) ‘hepialine’ venation, v) ♂ hindwing 1A and 2A complete (Fig. 25), vi) ♀ hindwing 1A, 2A and 3A complete (Fig. 26), vii) ♀ hindwing 1A and 2A closer at basal half (Fig. 26), viii) arolium present, and ix) tergite and sternite VIII sclerotised in both sexes.

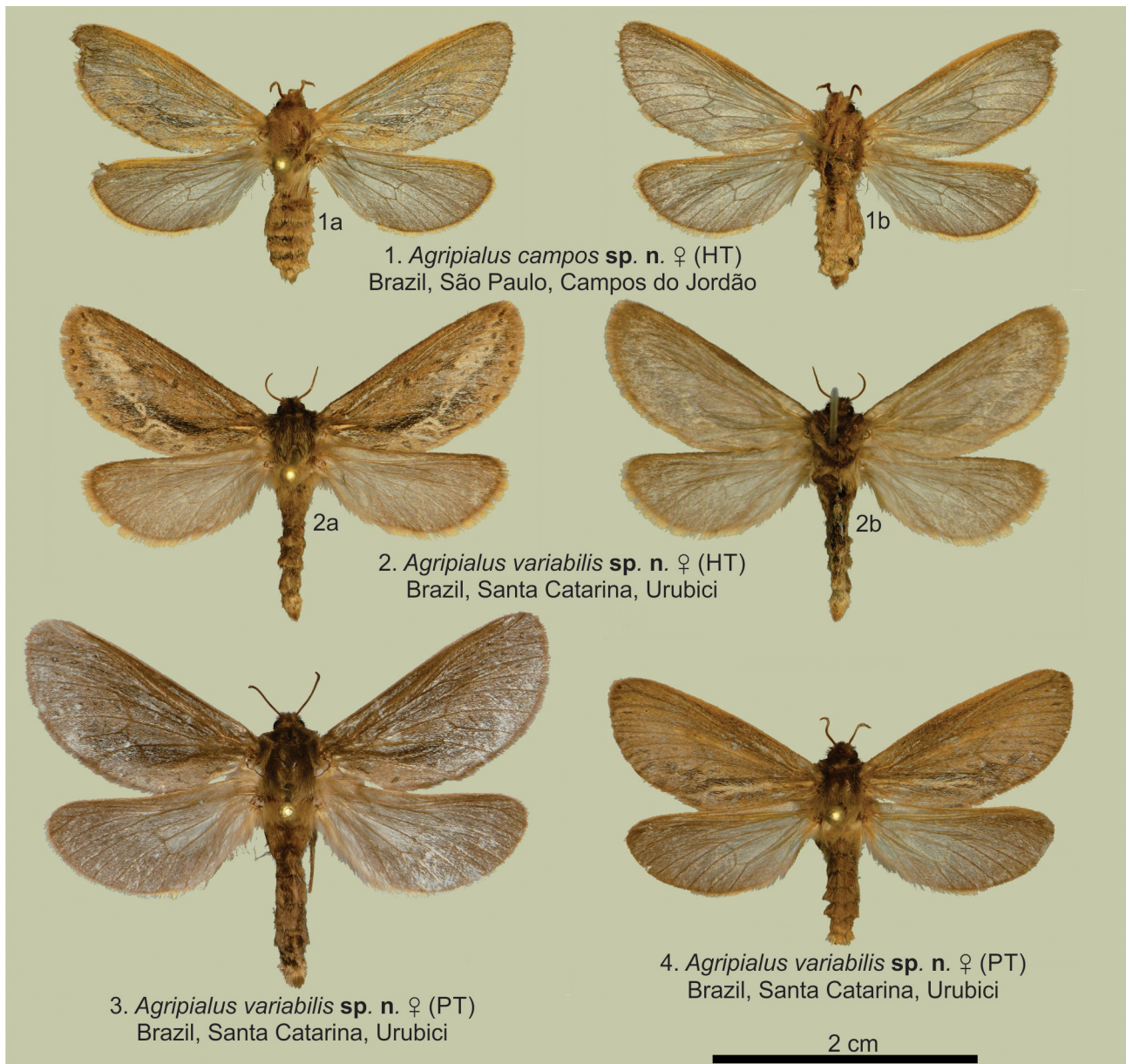
Description. Male (Figs 5, 7, 22–23, 25, 40, 43–44, 47–48).

Head. Clypeus glabrous, projected, and differentiated from frons. Frons with piliform and porrect scales, transverse ocular scale tuft from medial eye margin. Vertex scales as for frons. Eyes large, occupying 3/5 of the head in anterior view. Labial palps trisegmented. Antenna lamellate, each segment ventrally projected, scattered sensilla caetica and sensilla trichodea present; scape and pedicel with scales as for frons.

Thorax. Legs (Figs 22–23): epiphysis and arolium present. Venation (Fig. 25): fore- and hindwing without Sc1; hindwing CuP absent, 1A and 2A complete; hindwing Sc and Rs separated. Dorsal forewing ornamentation slightly marked by transverse blackish patch between cubital veins which sometimes extends disto-anteriorly, in parallel to outer margin. Ventral forewing, dorsal and ventral hindwing uniformly coloured, sometimes darker distally, unornamented.

Abdomen (Figs 40, 43–44). Tergosternal sclerite with strongly curved tergosternal bar curving disto-anteriorly, intermediate zone weakly sclerotized with robust posterior edge angled ventrally almost to tergosternal bar separated by narrow ‘notch’; lateral ridge anterior to tergosternal bar short, dorsal ridge not fused with anterior ridge of tergum I. Tergite and sternite VII and VIII sclerotized.

Genitalia (Figs 47–48). Tegumen fused to pseudotegumen. Tergal lobes and posterior portion of pseudotegumen membranous. Pseudotegumen fused anteriorly. Fultura superior membranous. Valva elbowed and heavily sclerotised.



FIGURES 1–4. *Agripialus* gen. n. spp. Adults. **1.** *A. campos* sp. n.: HT ♀: dorsal view (1a), ventral view (1b) (DZUP). **2–4.** *A. variabilis* sp. n.: **2.** HT ♀: dorsal view (2a), ventral view (2b) (DZUP); **3.** PT ♀ (CGCM 38.764): dorsal view (DZUP); **4.** PT ♀ (CGCM 38.744): dorsal view (DZUP).

Female (Figs 1–4, 6, 20–21, 26, 29, 31–33, 36–37, 51–53).

Head. As for male.

Thorax. Legs (Figs 20–21): as for male. Venation (Fig. 26): 1A, 2A and 3A complete.

Abdomen (Figs 29, 31–33). As for male.

Genitalia (Figs 51–53). Each dorsal plate (tergite IX) dorsally separated, other than a sclerotised dorsal ridge or a thickened membrane; ventrally separated from lamella antevaginalis. Latter W-shaped with mesal fusion of each of lateral plates. Ductus bursae tube-like and corpus bursae globular.

Etymology. *Agripialus* gen. n. comes from the Latin prefix *Agri-* (field, open land) added ‘*pialus*’ extracted from the first described Hepialidae genus *Hepialus* Fabricius. The name is a reference of the biotope where all species described below have been found, areas with natural grasslands. The gender is masculine.

Geographical distribution. Known from eastern Minas Gerais to Rio Grande do Sul in Brazil and likely to northeastern (Tucumán) and eastern (Buenos Aires) Argentina (Fig. 58). It appears to be restricted to areas where

grasslands are part of the natural vegetation (Figs 59–62). Such biotopes are typical of humid subtropical areas at moderate to high altitudes. Although not examined, two records are known to us from Argentina. Both records are not taxonomically treated herein.

Remarks. All *Agripialus* **gen. n.** species are monovoltine in late spring and summer.

A single female specimen potentially of *Agripialus* **sp. n.** from northeastern Argentina (Fig. 58, white circle), not dissected, was not included because this is an article dedicated to the Brazilian fauna. If indeed confirmed, the distribution of the genus would not only be greatly expanded but also disjunct between the Andes and Atlantic coast. A second female from another potential *Agripialus* **sp. n.** from south of Buenos Aires in Argentina (Fig. 58, question mark) was presented to us by Ezequiel Núñez Bustos (Buenos Aires) through an image only. Such a record, almost at sea level, would represent a further range boundary within the grassland biotope.

Agripialus campos **sp. n.**

(Figs 1, 20, 31, 36, 51)

Type material. Holotype ♀ (Figs 1a–b): Brazil – SP [São Paulo], Campos do Jordão, 1898 m, 6.I.1997, R. Koike leg., W 45°25'39", S 22°43'10"/ 33.220 Col. C. Mielke/ HOLOTYPUS, *Agripialus campos* C. Mielke, Grehan & Koike, 2021/ (DZUP).

Paratypes (3♀). **BRAZIL. São Paulo:** same locality as holotype: 2♀, 11–14.I.1996, P. Wagner leg. (CGCM 31.833 (CGCM), CGCM 31.875 (MGCL)); 1♀, 23–24.I.1998, R. Koike leg. (CGCM 36.093 (CGCM)).

Diagnosis. Distinguished in the female from its most similar relative, *Agripialus variabilis* **sp. n.**, by the shield-like shape of the subanal plate, and the wider ductus bursae (Fig. 51).

Description. Male. Unknown.

Female (Figs 1, 20, 31, 36, 51).

Head. Antenna with ~44 antennomeres. Basal and distal labial palpomeres equal in length, second segment one and a half to two times longer.

Thorax. Forewing length: 15–17 mm, wingspan: 30–35 mm. Wing ornamentation as shown in Fig 1.

Genitalia (Fig. 51). Dorsal plate laterally convex, ventral margin concave with rounded medial corner (anal papillae), medial margin shallowly concave; subanal plate shield-like (mostly obscured by anal papillae in Fig. 51); ductus bursae subequal in length to that of ovoid corpus bursae.

Geographical distribution. Known from the type locality only at 1900 m (Figs 58, 60).

Host plants. Unknown.

Etymology. The proposed specific name is homonymous to the first name of the municipality, Campos dos Jordão, where this species is found. It is treated as a noun in the nominative singular in apposition.

Agripialus variabilis **sp. n.**

(Figs 2–4, 21, 29, 32, 37, 52)

Type material. Holotype ♀ (Figs 2a–b): Brazil – SC [Santa Catarina], Urubici, Santa Bárbara, 1360 m, 25.-27.XII.2019, 28° 8'30.70" S, 49° 38'6.84" W, C. Mielke & E. Joerke leg./ 41.065 Col. C. Mielke/ HOLOTYPUS, *Agripialus variabilis* C. Mielke, Grehan & Koike, 2021/ (DZUP).

Paratypes (7♀). **BRAZIL. Paraná:** 2♀, Curitiba: 4.II.1975 (CGCM 15.404 (MGCL)); 18.II.1975, V. O. Becker leg. (CGCM 15.746 (CGCM)). **Santa Catarina:** 1♀, São Bento do Sul, Rio Natal, 4.IX.1999, A. Rank leg. (CGCM 7261 (CGCM)); 2♀, same locality and collector as the holotype, 1.–3.II.2019 (CGCM 38.744 (CGCM), CGCM 38.764 (DZUP)); 1♀, São Joaquim, 22–24.I.1983, 1400 m, V. Becker leg. (CGCM 15.036 (CGCM)). **Rio Grande do Sul:** 1♀, 28–31.I.2000, São José dos Ausentes, Silveira, 1200 m, A. Moser leg. (CGCM 3.652 (CGCM)).

Diagnosis. Distinguished from its most similar species by differences in the shape of the subrectangular subanal plate, particularly the narrow lobate dorso-posterior corner, and the narrower (by about half) ductus bursae (Fig. 52).

Description. Male. Unknown.

Female (Figs 2–4, 21, 29, 32, 37, 52).

Head. Antenna with ~42 antennomeres. Basal and distal labial palpomeres equal in length, second segment one and a half to two times longer.

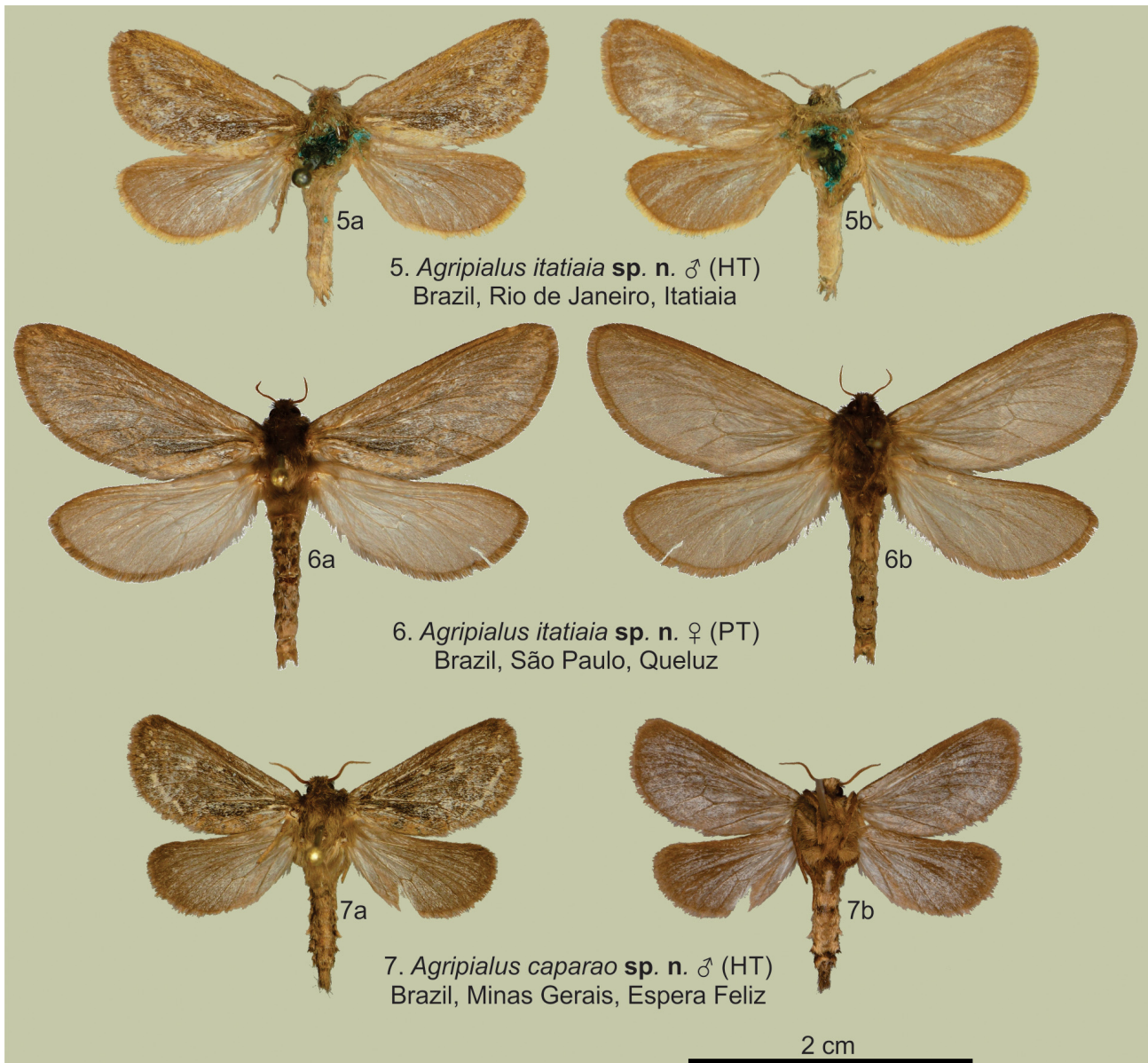
Thorax. Forewing length: 15–22 mm, wingspan: 35–45 mm. Wing ornamentation as shown in Figs 2–4.

Genitalia (Fig. 52). Dorsal plates connected by thickened membranous cuticle or by a narrow sclerotised bar. Dorsal plate subrectangular with shallow convex lateral edge; shallow dorsal, ventral, and medial edges with lobe shaped dorsal corner. Lamella antevaginalis weakly sclerotized, in some cases with a ventrally oriented anterior tip. Subanal plate slightly sclerotised, subrectangular. Ductus bursae length subequal to corpus bursae.

Geographical distribution. Known from southern Brazil in eastern Paraná, Santa Catarina and northeastern Rio Grande do Sul at altitude ranging from 800 to 1400 m (Figs 58, 62).

Host plants. Unknown.

Etymology. The proposed specific name alludes to variation in the ornamentation of the forewing dorsally (Figs 2a, 3–4). It is treated as an adjective in the nominative singular.



FIGURES 5–7. *Agripialus* gen. n. spp. Adults. **5–6.** *A. itatiaia* sp. n.: 5, HT ♂: dorsal view (5a), ventral view (5b) (CEIOC); 6, PT ♀ (CGCM 25.532): dorsal view (6a), ventral view (6b) (CGCM). **7.** *A. caparao* sp. n.: HT ♂: dorsal view (7a), ventral view (7b) (DZUP).

***Agripialus itatiaia* sp. n.**

(Figs 5–6, 22, 26, 33, 43, 47, 53)

Type material. Holotype ♂ (Figs 5a–b): 4,- XII, [19]26/ No. 24, J. F. Zikán/ Coleção J. F. Zikan/ Z. 4713/ HOLOTYPUS, *Agripialus itatiaia* C. Mielke, Grehan & Koike, 2021/ (CEIOC).

Paratype (1♀). **BRAZIL. São Paulo:** Queluz, Serra Fina, 2400 m. 7.XI.1986 (CGCM 25.532 (CGCM)).

Diagnosis. Easily distinguished from congeneric species by a longer antero-posterior trapezoidal sternite VII (as long as sternite VI) in the female (Fig. 33), in contrast to the proportionately wider rectangle of the other two species, and by the length of the ductus bursae being four times longer than the corpus bursae (Fig. 53). The male differs from that of *Agripialus caparao* sp. n.] by absence of a whitish submarginal line on the forewing (Fig. 5a) and the presence of a minute sclerotised square on the posterior portion of the pseudotegumen (Fig. 47).

Description. Male (Figs 5, 22, 43, 47).

Head. Antenna with ~37 antennomeres. Basal and second labial palpomeres each respectively three and five times longer than distal palpomere.

Thorax. Forewing length: 15 mm, wingspan: 31 mm. Wing ornamentation as shown in Fig. 5.

Genitalia (Fig. 47). Tegumen L-shaped. Saccus broadly U-shaped, posterior margin slightly notched. Pseudotegumen weakly sclerotised with a small rectangular sclerotisation posteriorly; anteriorly rectangular as a transverse bar, fused mesally and internally projected to articulate with fultura inferior. Fultura inferior posteriorly concave, projecting, and tapered anteriorly with concave lateral margins. Valva setose, distal half strongly sclerotised as long as basal portion.

Female (Figs 6, 26, 33, 53).

Head. Antenna with 32 antennomeres. Basal and second labial palpomere respectively two and three times longer than distal palpomere.

Thorax. Forewing length: 20 mm, wingspan: 40 mm. Wing ornamentation as shown in Fig 6.

Genitalia (Fig. 53). Connection between dorsal plates slightly sclerotized, dorsal plate subrectangular with broad, rounded ventral medial corner (anal papilla), and narrow knob-like antero-lateral corner; subanal plate slightly sclerotised, subrectangular. Lamella antevaginalis slightly sclerotized. Ductus bursae four times longer than corpus bursae.

Geographical distribution. Only known from a single site in Itatiaia National Park at 2400 m (Figs 58, 61).

Host plants. Unknown.

Etymology. The proposed specific name is homonymous to the national park's name. It is treated as a noun in the nominative singular in apposition.

***Agripialus caparao* sp. n.**

(Figs 7, 23, 25, 40, 44, 48)

Type material. Holotype ♀ (Figs 7a–b): Brazil – Minas Gerais (MG), Espera Feliz, nr. Pedra Menina (ES), Casa Queimada, 2.200 m, 19.XI.2017, 20°27'28.57''S, 41°48'31.46''W, R. Koike & E. Pereira leg./ 35.884 Col. C. Mielke/ HOLOTYPUS, *Agripialus caparao* C. Mielke, Grehan & Koike det. 2021/ (DZUP).

Paratype (1♂). **BRAZIL.** Same locality as holotype, 12.XI.2012, Lepidoptera Lab. expedition (MZSP).

Diagnosis. Distinguished in the male from its most similar species *A. itatiaia* sp. n. by the pseudotegumen lacking sclerotisation posteriorly and by the thinner transverse portion anteriorly (Fig. 48). The whitish submarginal line on the forewing (Fig. 7a) is also absent in the *A. itatiaia* (Fig. 5a).

Description. Male (Figs 7, 23, 25, 40, 44, 48).

Head. Antenna with 37 antennomeres. Basal and second labial palpomere respectively two and four times longer than distal palpomere.

Thorax. Forewing length: 12 mm, wingspan: 26 mm. Wing ornamentation as shown in Fig 7.

Genitalia (Fig. 48). Tegumen L-shaped. Saccus U-shaped, antero-posteriorly short, posterior margin slightly notched. Pseudotegumen narrow, anteriorly rectangular, almost transverse, fused mesally, and interiorly projected to articulate with fultura inferior. Fultura inferior subtriangular. Valva setose, distal portion strongly sclerotised as long as basal portion.

Female. Unknown.

Geographical distribution. Known from the type locality only at 2200 m (Figs 58, 59).

Host plants. Unknown.

Etymology. The proposed specific name is homonymous to the national park's name. It is treated as a noun in the nominative singular in apposition.

***Mutipialus* gen. n.**

(Figs 8–15, 16–17, 24, 27–28, 30, 34–35, 38–39, 41–42, 45–46, 49–50, 54–57)

Type species: *Mutipialus dilatus* sp. nov. by present designation.

Included species: *M. dilatus* sp. n. and *M. monticolus* sp. n.

Diagnosis. Distinguished from all other Hepialidae by the broad dorso-posterior plates of the tergal lobe and pseudotegumen (Figs 49–50) and from all other New World Hepialidae by a pocket-like caecum formed by separation of the dorsal and ventral walls of the saccus (Figs 49a–50a). Also distinct among other South American Hepialidae by the following combination of characters: i) prominent transverse scale tuft over the eyes emerging between the base of the antenna and the eye margin (Figs 16–17), ii) labial palpus trisegmented (Fig. 17), iii) antenna lamellate, iv) 'hepialine' venation, v) forewing CuP distally connected to A vein distally (Figs 27–28), vi) ♂ hindwing 1A and 2A complete (Fig. 27), vii) ♀ hindwing 1A, 2A (Fig. 28), viii) ♀ hindwing 1A and 2A proximate in basal half (Fig. 28), ix) arolium present, x) sternite VIII membranous in females (Figs 34–35) and, xi) pseudotegumen unfused dorsally and fused across median ventrally (Figs 49b–c, 50b–c).

Description. Male (Figs 11–12, 14, 16, 24, 27, 30, 41–42, 45–46, 49–50).

Head. Clypeus glabrous, projected anteriorly, differentiated from frons. Frons with piliform and porrect scales, transverse scale tuft over eyes. Vertex scales as for frons. Eyes large, occupying 3/5 of head in anterior view. Labial palps trisegmented. Antenna lamellate, sensilla caetica sparse, sensilla trichodea present; scape and pedicel with scales as for frons.

Thorax. Legs (Fig. 24): epiphysis and arolium present. Venation (Fig. 27): forewing without Sc1, CuP connected to A distally; hindwing without Sc1, CuP absent, 1A and 2A complete; Sc and Rs separated.

Abdomen (Figs 41–42, 45–46). Tergosternal sclerite with tergo-sternal bar curving disto-anteriorly, intermediate zone weakly sclerotized with robust posterior edge angled ventrally to, but not fused with posterior margin of tergo-sternal bar; lateral ridge anterior of tergo-sternal bar very short, dorsal ridge not fused with anterior ridge of tergum I. Tergite and sternite VII and VIII sclerotized.

Genitalia (Figs 49–50). Tegumen and tergal lobes fused to pseudotegumen. Saccus with dorsal and ventral walls forming an inflated space. Pseudotegumen unfused dorsally, fused ventrally; anogenital margin with lateral ridge. Fultura inferior and superior sclerotised.

Female (Figs 8–10, 13, 15, 17, 28, 34–35, 38–39, 54–57).

Head. As for male.

Thorax. Legs: as for male. Venation (Fig. 28): 1A, 2A and 3A complete.

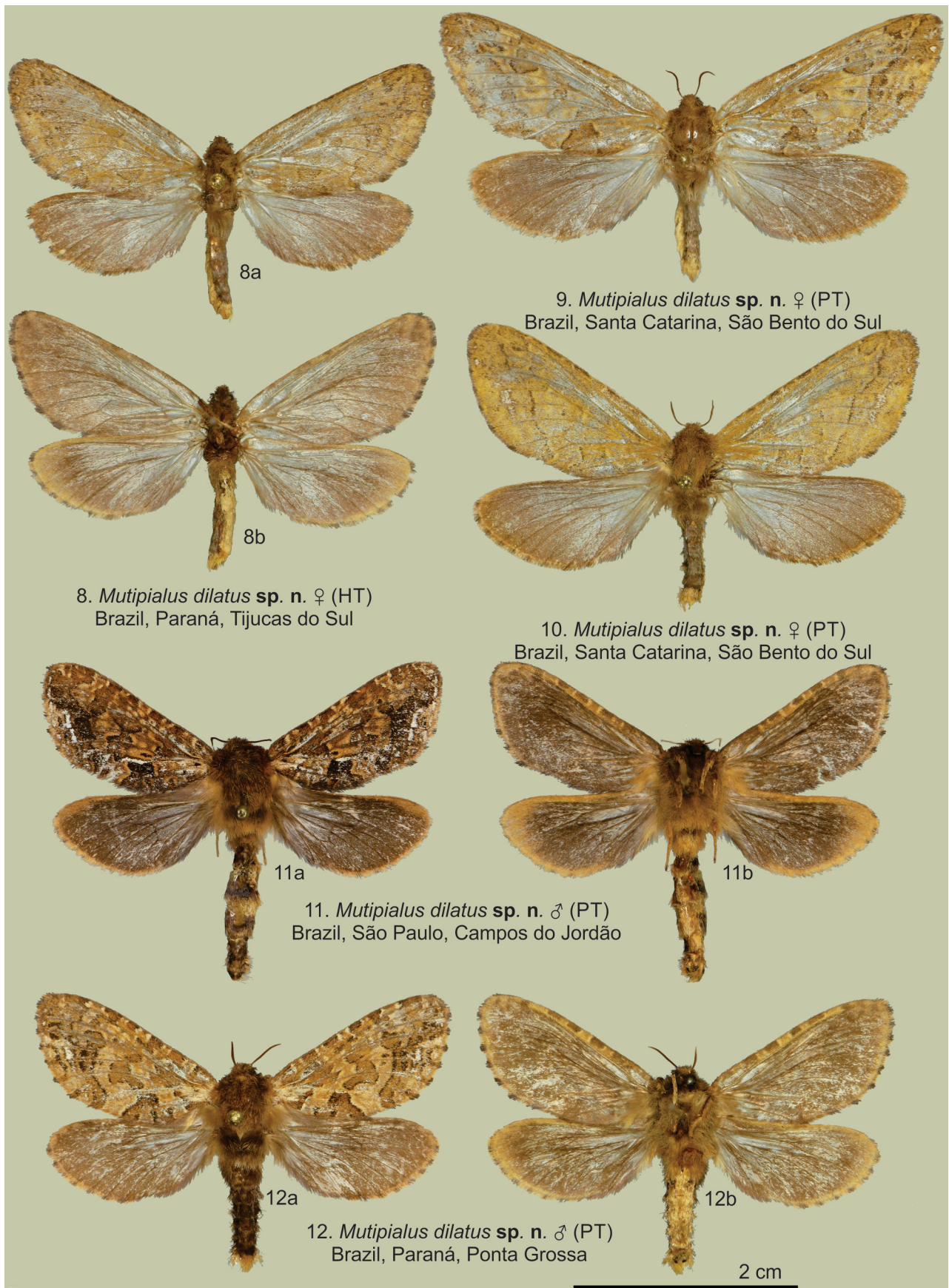
Abdomen (Figs 34–35, 38–39). As for male. Sternite VIII membranous.

Genitalia (Figs 54–57). Tergite IX slightly projecting posteriorly. Lamella antevaginalis forming continuous plate without dorsal margin forming distinct medial or lateral lobes. Ductus bursae tubular, and corpus bursae similar to ductus, but of variable width, narrower or wider near junction with ductus bursae.

Etymology. *Mutipialus* gen. n. comes from the Latin prefix *Muti-* (shortened) added to *-pialus* extracted from the first described Hepialidae genus *Hepialus* Fabricius. The name refers to the shortened body appearance of the two new species. The gender is masculine.

Geographical distribution. Known from southeastern Minas Gerais to northeastern Santa Catarina (Fig. 58).

Remarks. All *Mutipialus* gen. n. species are monovoltine with spring and summer emergence.



FIGURES 8–12. *Mutipialus dilatus* sp. n. Adults. **8**, HT ♀: dorsal view (8a), ventral view (8b) (DZUP). **9**, PT ♀ (CGCM 7.584): dorsal view (CGCM). **10**, PT ♀ (CGCM 18.103): dorsal view (CGCM). **11**, PT ♂ (CGCM 41.733): dorsal view (11a), ventral view (11b) (CGCM). **12**, PT ♂ (CGCM 23.689): dorsal view (12a), ventral view (12b) (CGCM).

Mutipialus dilatus sp. n.

(Figs 8–12, 16, 24, 27–28, 30, 34, 38, 41, 45, 49, 54, 56)

Type material. Holotype ♀ (Figs 8a–b): [Brazil], 7.IX.1998, Vossoroça, Tijucas do Sul, PR. [Paraná] 850 m, C. Mielke leg./ 5.801 Col. C. Mielke/ HOLOTYPUS, *Mutipialus dilatus* C. Mielke, Grehan & Koike, 2021/ (DZUP).

Paratypes (5♂, 2♀). **BRAZIL. Minas Gerais:** 1♂, Conceição dos Ouros, 800 m, 10.XI.1993. E. Pereira leg. (CGCM 27.435 (MGCL)). **Rio de Janeiro:** 1♂, Itatiaia, Itatiaia Nat. Park, Maromba, Pto. Escada, 1170 m, 6.XI.2012, 22°25'45" S 44°37'08" W, Lepidoptera Lab. expedition (MZSP). **São Paulo:** 1♂, Campos do Jordão, Lavrinhas, 31.X.1990, R. Koike leg. (CGCM 41.733 (CGCM)); 1♂, Santo André, Vila Paranapiacaba, Parque Municipal Nascentes de Paranapiacaba, 1100 m, 14.XI.2020, R. Koike leg. (DZUP). **Paraná:** 1♂, Ponta Grossa, Vila Estrela, 900 m, 6.X.1989, C. Mielke leg. (CGCM 23.689 (CGCM)). **Santa Catarina:** 1♀, São Bento do Sul, Rio Natal, 700 m, 20.X.1994, O. Rank leg. (CGCM 18.103 (CGCM)); 1♀, São Bento do Sul, Rio Vermelho, 800 m, 4.XI.1990 (CGCM 7.584 (CGCM)).

Diagnosis. Readily distinguished from congeneric species, described below, by (i) the contrasting mottled forewing ornamentation (Figs 8–12), (ii) ♂ triangular sternite VIII (Fig. 45), (iii) greatly expanded dorso-posterior plate of tergal lobe and pseudotegumen (Fig. 49), (iv) deeply concave fultura superior (Fig. 49c), (v) subtriangular valva and (vi) shorter corpus bursae that is only twice as long as the ductus bursae (Fig. 56).

Description. Male (Figs 11–12, 16, 24, 27, 30, 41, 45, 49).

Head. Antenna with ~38 antennomeres. Mesal and distal labial palpomere two and a half times longer than distal palpomere, respectively.

Thorax. Forewing length: 15–18 mm, wingspan: 28–35 mm. Wing ornamentation as shown in Figs 11–12.

Genitalia (Fig. 49). Tegumen oblique, rectangular, slightly curved, well distinguished from pseudotegumen by its stronger sclerotisation. Saccus U-shaped, posterior arms strongly sclerotised, anterior projection forming bag-like cavity. Tergal lobes and dorsal pseudotegumen fused and forming robust subtriangular wall, dorso-posteriorly projecting on each side, expanded and connected mesally by thicker membrane, antero-ventrally bifid; ridge emerges from digitiform antero-dorsal projection finely fused, posteriorly expanded as lateral shelf on each side. Fultura inferior trapezoidal. Fultura superior subtriangular and deeply concave (in ventral view). Valva subtriangular, lobated and curved distally with expanded costa.

Female (Figs 8–10, 28, 34, 38, 54, 56).

Head. Antenna with 40 antennomeres. Mesal and distal palpomere five times the length of the basal palpomere.

Thorax. Forewing length: 19–22 mm, wingspan: 38–45 mm. Wing ornamentation as shown in Figs 8–10.

Genitalia (Figs 54, 56). Dorsal plates narrow, slightly projected posteriorly. Lamella antevaginalis U-shaped, narrow, mesally setose, bilobed and slightly projecting posteriorly (narrowed in Fig. 54a). Subanal sclerites slightly sclerotised, subrectangular, oblique. Corpus bursae narrowing to junction with ductus bursae that is twice as long as the corpus bursae.

Geographical distribution. Known from southeastern Minas Gerais and Rio de Janeiro to northeastern Santa Catarina, at altitudes ranging from 700 to 1900 m (Figs 58, 60).

Host plants. Unknown.

Etymology. The proposed specific name *dilatus* (Latin) alludes to the species' broad geographic range. It is treated as an adjective in the nominative singular.

Mutipialus monticolus sp. n.

(Figs 13–15, 17, 35, 39, 42, 46, 50, 55, 57)

Type material. Holotype ♀ (Figs 13a–b): BRAZIL – São Paulo (SP), Campos do Jordão, Lavrinhas, 1898 m, 2.I.1999 (30), R. Koike leg., W 45°25'39" S 22° 43'10"/ 43.527 Col. C. Mielke/ HOLOTYPUS, *Mutipialus monticolus* C. Mielke, Grehan & Koike, 2021/ (DZUP).

Paratypes (1♂, 1♀). **BRAZIL.** Same locality and collector as the holotype: 1♀, 23–24.I.1998 (CGCM 35.737 (CGCM)); 1♂, 27–28.XII.1997 (CGCM 29.697 (CGCM)).

Diagnosis. Readily distinguished from congeneric species by i) ♂ forewing ground colour dark brown with

a light brown stripe on the CuA dorsally (Fig. 14a), (ii) ♂ sternite VII bilobed posteriorly (Fig. 46), (iii) posterior margin of the ventral wall of the saccus mesally projected posteriorly (Fig. 50b), (iv) tergal lobe and pseudotegumen less projected posteriorly, (v) ventro-posterior projection of the pseudotegumen tapered, not digitiform, (vi) fultura superior not as deeply concave, (vii) valva curved and subrectangular, and (viii) the longer ductus bursae and corpus bursae (one and a half times to that of *M. dilatus* sp. n.) (Fig. 57).



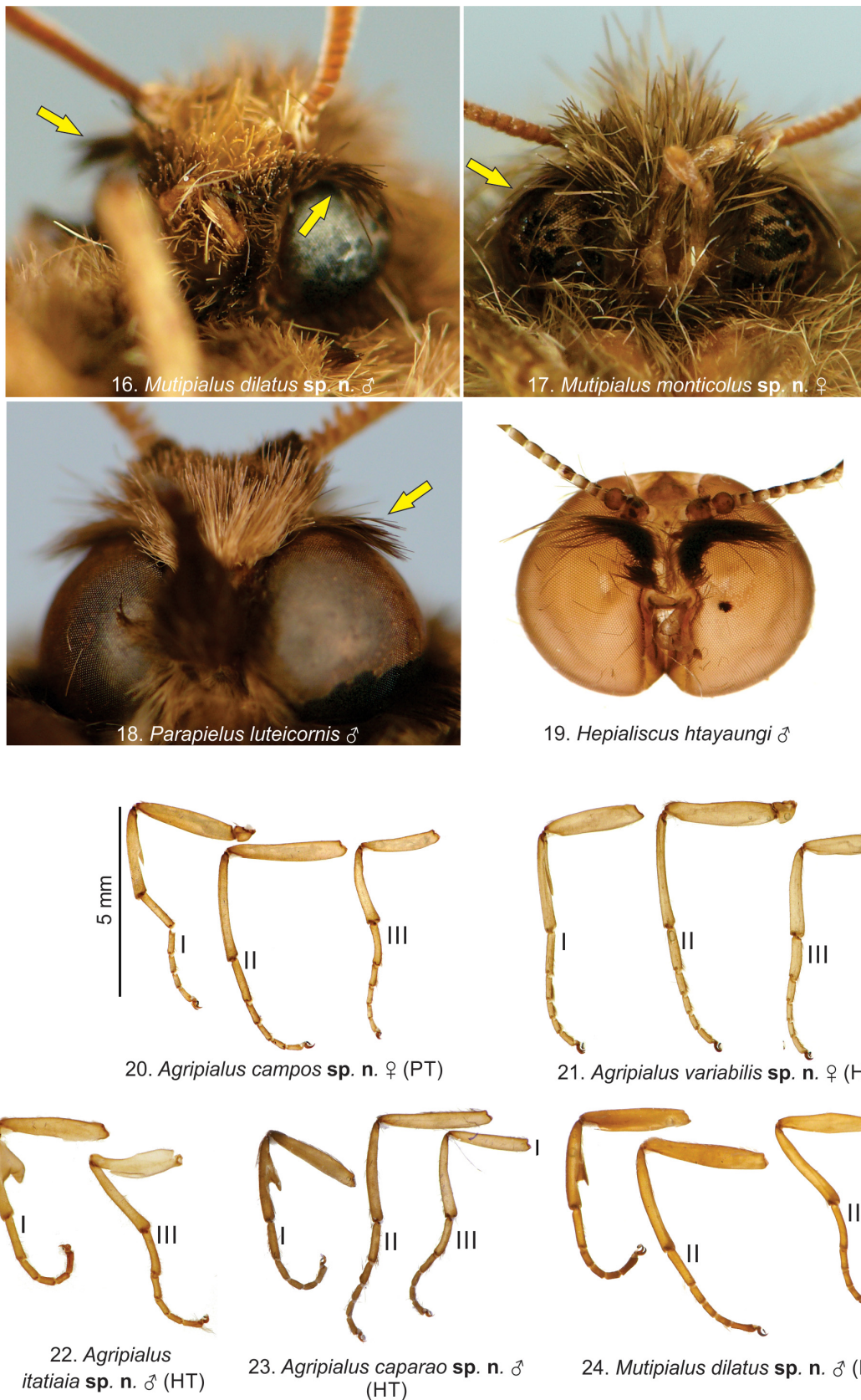
FIGURES 13–15. *Mutipialus monticolus* sp. n. Adults. **13**, HT ♀: dorsal view (13a), ventral view (13b) (DZUP). **14**, PT ♂ (CGCM 29.697): dorsal view (14a), ventral view (14b) (CGCM). **15**, PT ♀ (CGCM 35.737): dorsal view (15a), ventral view (15b) (CGCM).

Description. Male (Figs 14, 39, 42, 46, 50).

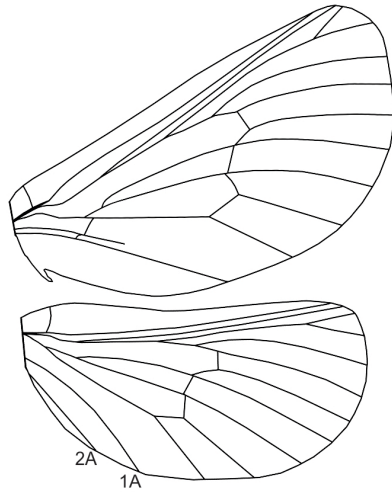
Head. Antenna with 32 antennomeres. Mesal and distal labial palpomere twice as long as basal palpomere.

Thorax. Forewing length: 13 mm, wingspan: 27 mm. Wing ornamentation as shown in Figs 14.

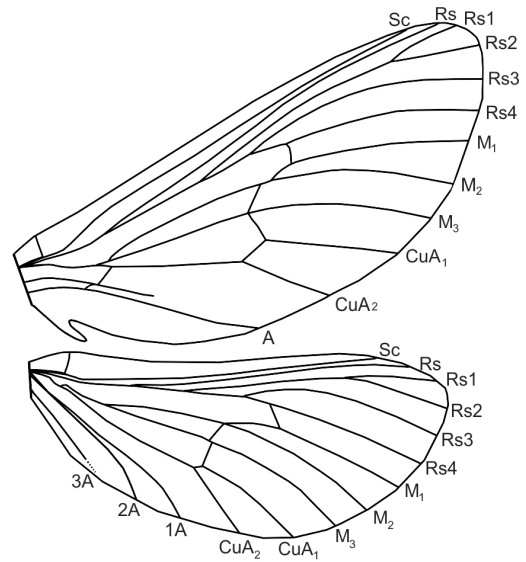
Genitalia (Fig. 50). Tegumen oblique, rectangular, slightly curved, and strongly differentiated, by sclerotisation, from pseudotegumen. Saccus U-shaped, posterior arms slightly projected ventrally, ventro-posterior margin projected as a shelf. Tergal lobes and pseudotegumen forming a robust and irregular shaped structure; dorso-posteriorly each side extending posteriorly and connected mesally by robust membrane, both sides ventrally projected, with expanded posterior edges and bifid anteriorly; a finely fused ridge emerges from the digitiform antero-dorsal projection and expands posteriorly as a shelf on each side. Fultura inferior trapezoidal. Fultura superior subsquare, slightly concave (in ventral view). Valva subrectangular, curved with slightly lobate costa.



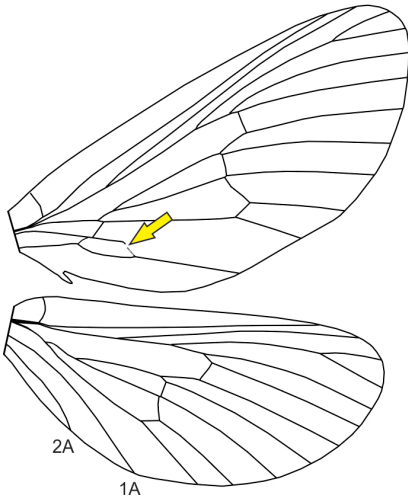
FIGURES 16–24. Transverse scales and legs. **Figs 16–19.** Transverse scales (arrowed). 16, *Mutipialus dilatatus* sp. n. PT ♂ (CGCM 23.689). 17, *M. monticolus* sp. n., HT ♀. 18, *Parapielus luteicornis* ♂ (CGCM 28.544, Argentina, Rio Grande; CGCM). 19, *Hepialiscus htayaungi* ♂ (CGCM 33.586, Myanmar; CGCM). **Figs 20–24.** Legs. 20, *Agripialus campos* sp. n., PT ♀ (CGCM 31.875). 21, *A. variabilis* sp. n., HT ♀. 22, *A. itatiaia* sp. n., HT ♂. 23, *A. caparao* sp. n., HT ♂. 24, *Mutipialus dilatatus* sp. n., PT ♂ (CGCM 27.435).



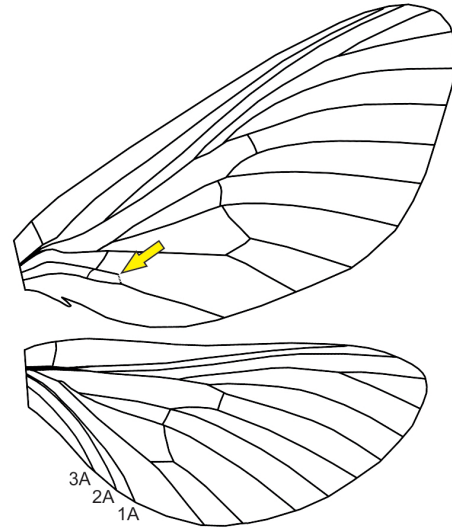
25. *Agripialus caparao* sp. n. ♂



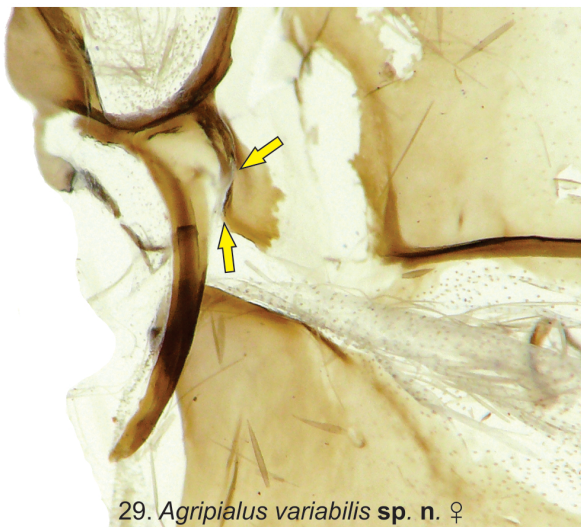
26. *Agripialus itatiaia* sp. n. ♀



27. *Mutipialus dilatus* sp. n. ♂



28. *Mutipialus dilatus* sp. n. ♀

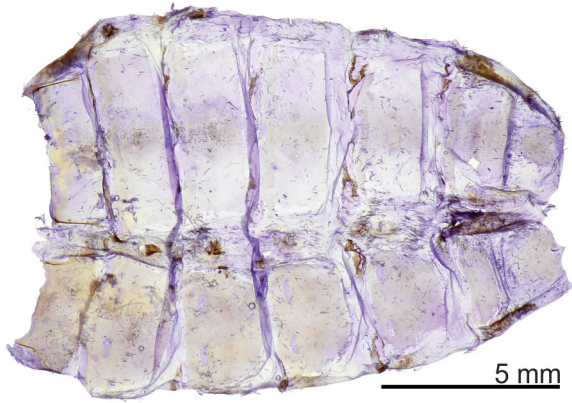


29. *Agripialus variabilis* sp. n. ♀



30. *Mutipialus dilatus* sp. n. ♂

FIGURES 25–30. Wing venation and tergosternal sclerite. **Figs 25–28.** Wing venation. **25,** *Agripialus caparao* sp. n., ♂. **26,** *A. itatiaia* sp. n., ♀. **27–28,** *Mutipialus dilatus* sp. n., ♂ (27), ♀ (28); arrow pointing to the connection between CuP and A veins in forewing. **Figs 29–30.** Tergosternal sclerite. **29,** *Agripialus variabilis* sp. n., ♀; arrows pointing to the notch and the posterior portion. **30,** *Mutipialus dilatus* sp. n., ♂.



31. *Agripialus campos* sp. n. ♀ (PT)



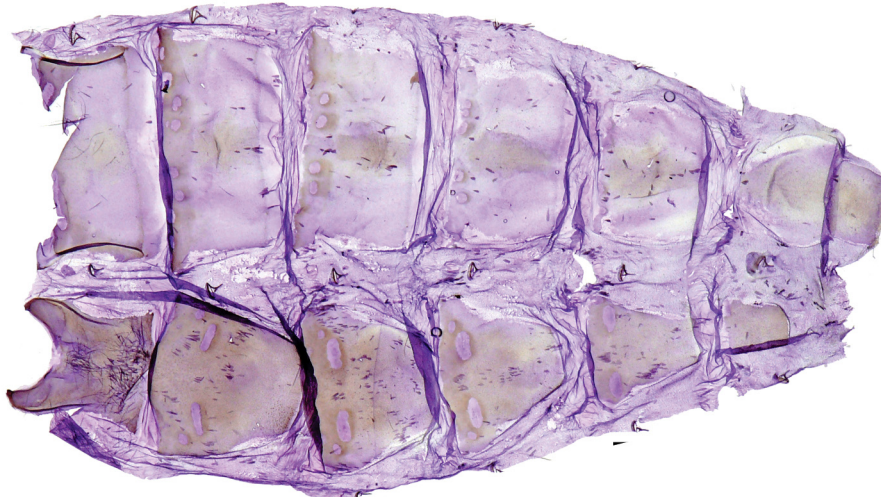
32. *Agripialus variabilis* sp. n. ♀ (HT)



33. *Agripialus itatiaia* sp. n. ♀ (PT)

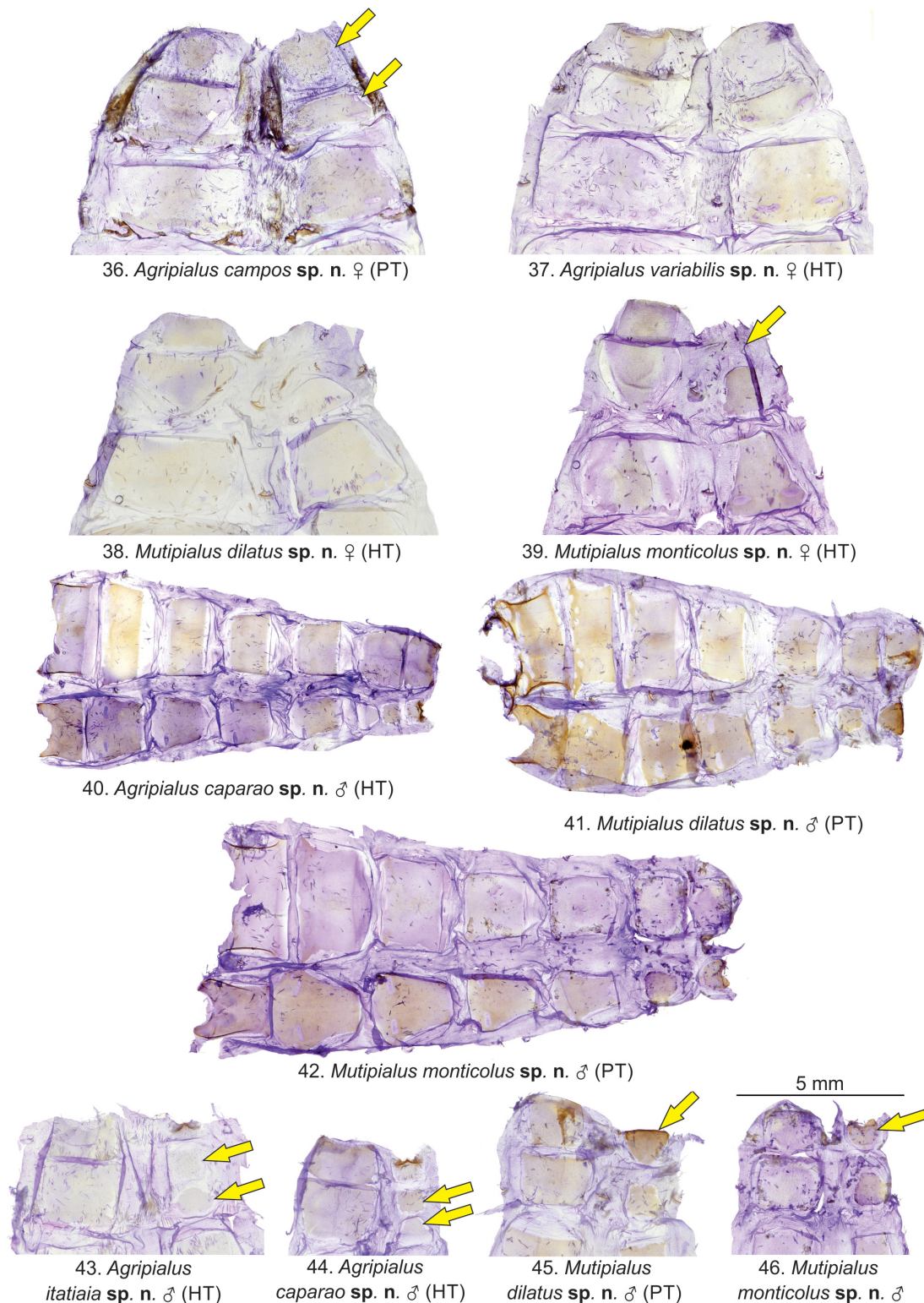


34. *Mutipialus dilatatus* sp. n. ♀ (HT)

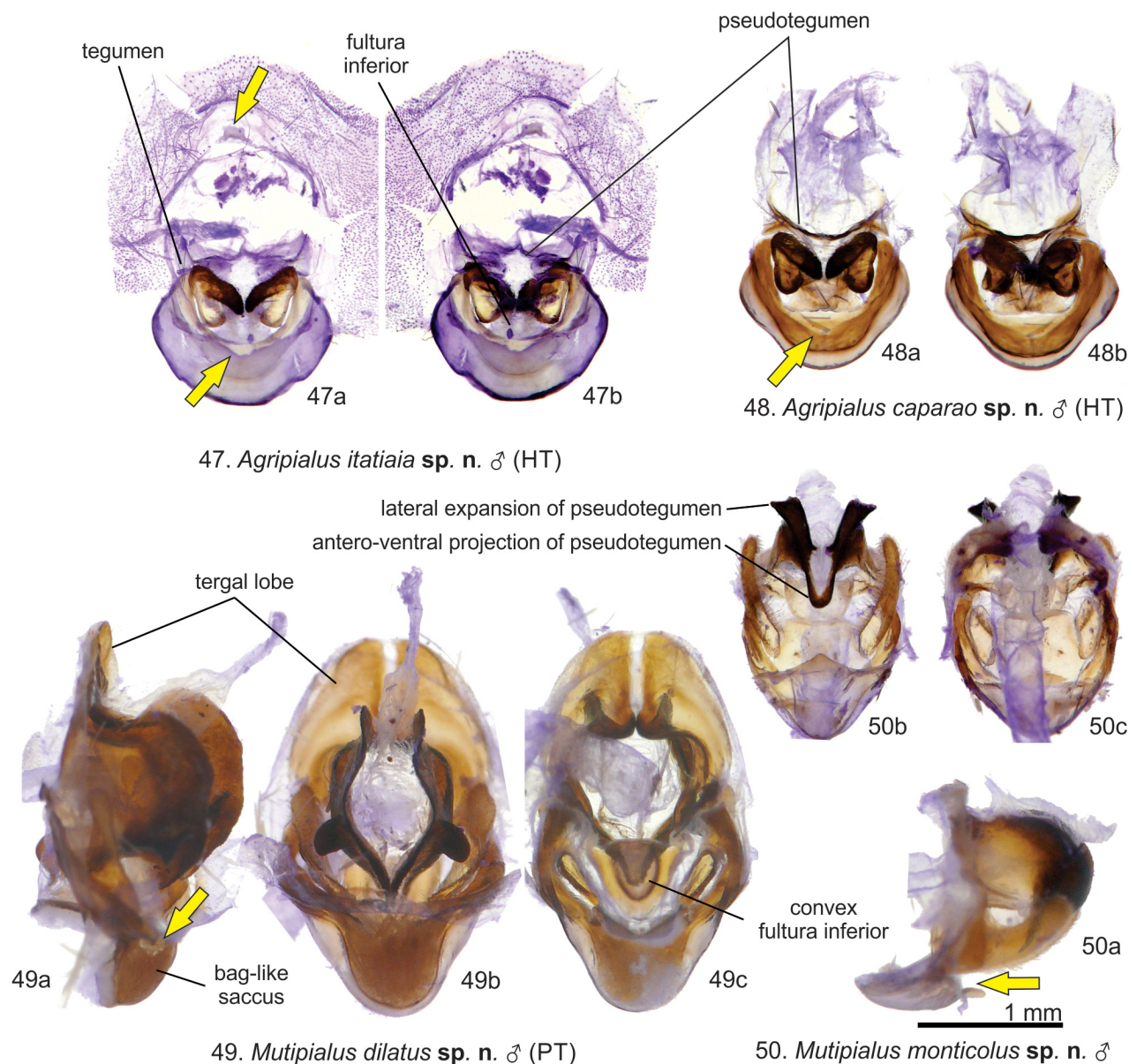


35. *Mutipialus monticolus* sp. n. ♀ (HT)

FIGURES 31–35. Female abdomen (upper side, tergites; lower side, sternites). **31**, *Agripialus campos* sp. n., PT (CGCM 31.875). **32**, *A. variabilis* sp. n., HT. **33**, *A. itatiaia* sp. n., PT (CGCM 25.532). **34**, *Mutipialus dilatatus* sp. n., HT (CGCM 5.801). **35**, *M. monticolus* sp. n., HT.



FIGURES 36–46. Abdomen. **Figs 36–39.** Female segments VI (lower)–VIII (upper). **36**, *Agripialus campos* sp. n., PT (CGCM 31.875); arrows pointing to the sclerotised sternites VII and VIII. **37**, *A. variabilis* sp. n., HT. **38**, *Mutipialus dilatus* sp. n., HT (CGCM 5.801). **39**, *M. monticolus* sp. n., HT; arrow pointing to the membranous sternite VIII. **Figs 40–42.** Male abdomen (upper side, tergites; lower side, sternites). **40**, *Agripialus caparao* sp. n., HT. **41**, *M. dilatus* sp. n., PT (CGCM 27.435). **42**, *M. monticolus* sp. n., PT (CGCM 29.697). **Figs 43–46.** Male segments VII (lower)–VIII (upper). **43**, *Agripialus itatiaia* sp. n., HT; arrows pointing to the two plates of the sternite VII. **44**, *A. caparao* sp. n., HT; arrows pointing to the two plates of the sternite VII. **45**, *Mutipialus dilatus* sp. n., PT (CGCM 27.435); arrow pointing to the sternite VIII. **46**, *M. monticolus* sp. n., PT (CGCM 29.697); arrow pointing to the sternite VIII.



FIGURES 47–50. Male genitalia. **47**, *Agripialus itatiaia* sp. n., HT: ventral (47a), dorsal (internal; 47b); arrows pointing to the posterior sclerotisation of the tergal lobe and pseudotegumen and the notch in the posterior margin of the saccus. **48**, *A. caparao* sp. n., HT: ventral (48a), dorsal (internal; 48b); arrow pointing to the notch in the posterior margin of the saccus. **49**, *Mutipialus dilatus* sp. n., PT (CGCM 27.435): lateral (49a), ventral (49b), dorsal (internal; 49c); arrow pointing to the entrance of the pocket-like saccus. **50**, *M. monticolus* sp. n., PT (CGCM 29.697): lateral (50a), ventral (50b), dorsal (internal; 50c); arrow pointing to the entrance of the pocket-like caecum.

Female (Figs 13, 15, 17, 35, 55, 57).

Head. Antenna with 34 antennomeres. Mesal and distal labial palpomere respectively three and two times the length of the basal palpomere (Fig. 17).

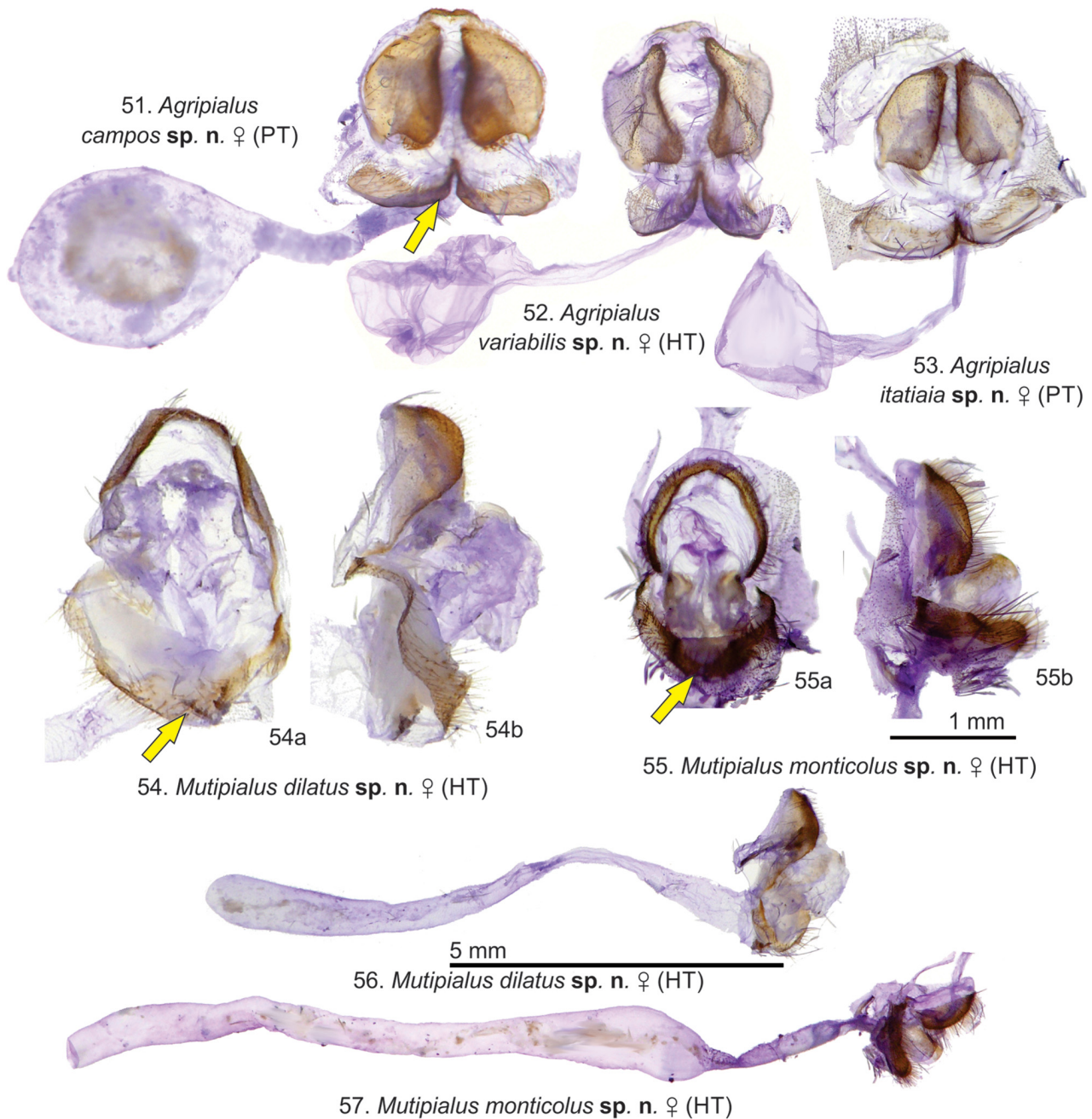
Thorax. Forewing length: 18–20 mm, wingspan: 39–42 mm. Wing ornamentation as shown in Fig 13, 15.

Genitalia (Figs 55, 57). Dorsal plates rectangular narrowing dorsally, fused dorsally to form narrow arc in posterior view. Lamella antevaginalis U-shaped, dorso-ventrally narrow, mesally setose and slightly projected medially (arrowed in Fig. 55a). Subanal sclerites lightly sclerotised, subrectangular, oblique. Corpus bursae two and a half times longer than ductus bursae and wider at junction with ductus bursae.

Geographical distribution. Only known from the type locality at higher elevations (1900 m) in the Mantiqueira Mountains of eastern São Paulo state (Figs 58, 60).

Host plants. Unknown.

Etymology. The proposed specific name alludes to the high altitude where this species occurs. It is treated as an adjective in the nominative singular.



FIGURES 51–57. Female genitalia. **51**, *Agripialus campos* sp. n., PT: posterior view and ductus and corpus bursae; arrow pointing to W-shaped lamella antevaginalis. **52**, *A. variabilis* sp. n., HT: posterior view and ductus and corpus bursae. **53**, *A. itatiaia* sp. n., PT (CGCM 25.532): posterior view and ductus and corpus bursae. **54**, *Mutipialus dilatus* sp. n., HT (CGCM 5.801): posterior (54a), lateral (54b); arrow pointing to slight mesal projection of the lamella antevaginalis. **55**, *M. monticolus* sp. n., HT: posterior (55a), lateral (55b); arrow pointing to slight mesal projection of the lamella antevaginalis. **56**, *Mutipialus dilatus* sp. n., HT (CGCM 5.801): ductus and corpus bursae. **57**, *M. monticolus* sp. n., HT: ductus and corpus bursae.

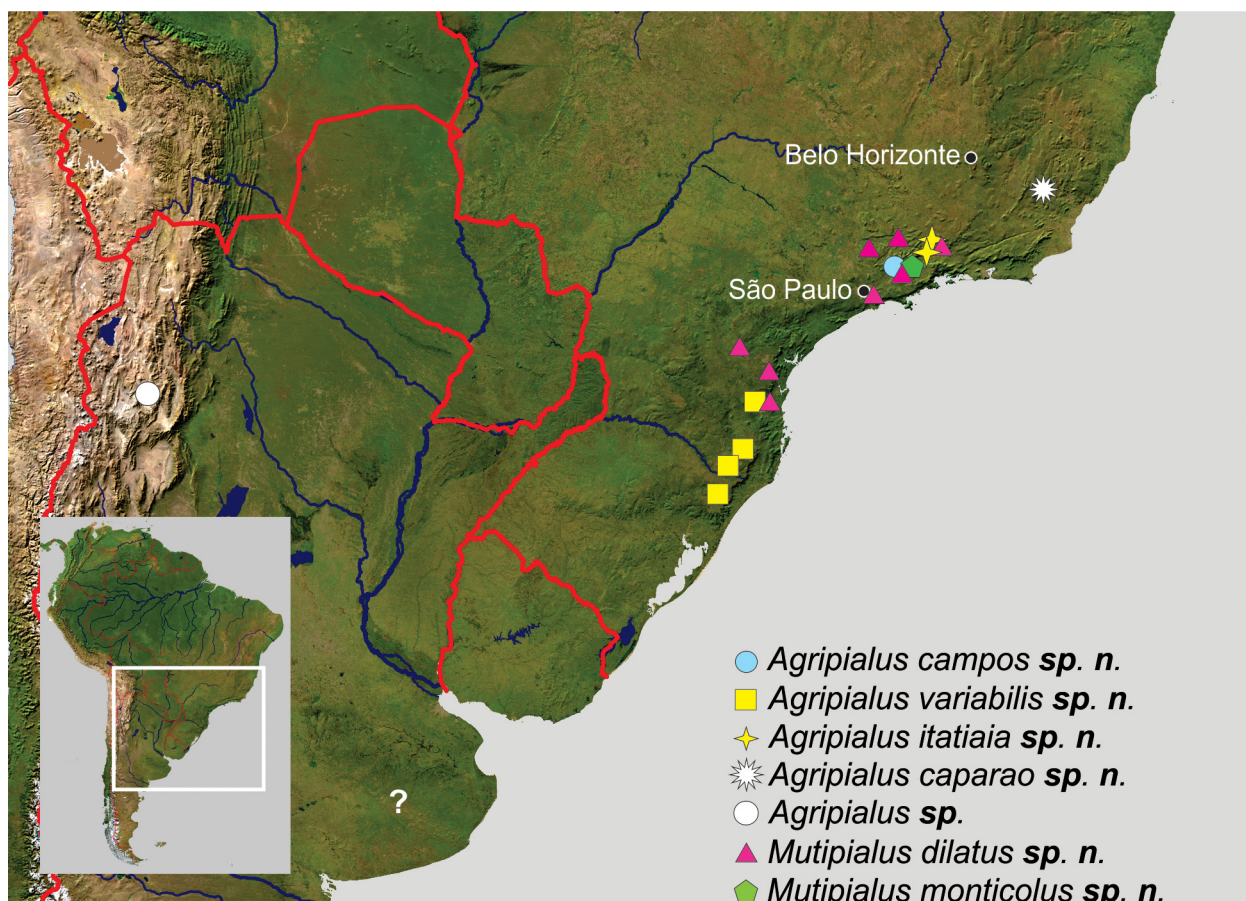


FIGURE 58. Distribution of *Agripialus* gen. n. spp. and *Mutipialus* gen. n. spp. within southern southeastern and southern Brazil and records of *Agripialus* gen. n. in Argentina (see remarks at the description of the genus).

Discussion

The male and female genitalia of *Agripialus* gen. n. and *Mutipialus* gen. n. are each distinct from all other Hepialidae. The unique and distinct morphological characters of both new genera could represent a close relationship with each other. This supposition is supported by their sharing two unique features: i) in the female hindwing, veins 1A and 2A are basally adjacent (in other Hepialidae, the basal portions of the veins are clearly separated); ii) the tergo-sternal bar of the tergo-sternal sclerite (Figs 29–30) is narrow and comma shaped, with the ventral apex extending well past the lateral arm of sternite II (in various other Hepialidae the tergo-sternal bar may have the form of a reverse ‘C’ (e.g. Grehan 2010), but without the smooth curvature of the anterior edge).

Phylogenetic affinities of *Agripialus* gen. n. and *Mutipialus* gen. n. to other hepialid genera are unresolved. The structure of the tergo-sternal sclerite and position of the hindwing Sc and R veins does not conform to the characteristics of the diverse multi genus from Central and South American ‘cibyrene’ clade (Grehan 2012). And they do not show any features to directly associate them with either the monotypic Peruvian *Viridigigas* Grehan & Rawlins, 2016 or *Pfitzneriana* Viette, 1952 clade from Ecuador-Peru (cf. Grehan & Rawlins 2016, Grehan & Mielke 2018). A further geographic cluster of genera is the southern Andean fauna of Chile and Argentina. Some genera such as *Dalaca* Walker, 1856 and *Callipielus* Butler, 1882 show evidence of a close phylogenetic relationship with each other (Nielsen & Robinson 1983) but the affinities of other genera remain unresolved. One feature present in *Agripialus* gen. n. and *Mutipialus* gen. n., that may be suggestive of a close relationship with some of the Andean genera is the trisegmented and proportionately long labial palps (at least four times longer than the prelabium; Fig. 17). This condition is applicable to the southern Andean genera *Blanchardinella* Nielsen, Robinson & Wagner, 2000, *Callipielus*, Butler, 1882, *Dalaca*, Walker, 1856, and *Parapielus* Viette, 1949. Three palpomeres are present in the Mexico-Central American genus *Phassus* Walker, 1856, but the proportional length of each palpomere is

reduced. Since three proportionately long palpomeres occur in the Hepialoid families Anomosetidae (Kristensen 1978), Prototheoridae (Davis 1996), and Neotheoridae (Simonsen & Kristensen 2017), the shared presence within the Hepialidae could represent a primitive retention. The similarity of this feature between the new genera and some of the Andean genera, while suggestive of a close relationship, is equivocal. An arolium is present in the new genera and also for some southern South American species of the genera *Puermytrans* Viette, 1951b and *Callipielus* (except in *C. argentata* Ureta, 1957 (Nielsen & Robinson 1983)). Although not unequivocally informative due to the widespread occurrence of this structure in other genera, it is absent in the cibyrene genera, the *Pfitzneriella* Viette, 1951a group, and *Viridigigas*. In this respect the two new genera are more similar to at least some of the southern Andean genera.



FIGURES 59–62. Habitats in Brazil. **59**, Caparaó National Park, 2200 m, Espera Feliz, Minas Gerais (*Agripialus caparao* sp. n.). **60**, Lavrinhas, 1900 m, Campos do Jordão, São Paulo (*A. campos* sp. n., *Mutipialus dilatus* sp. n., and *M. monticolus* sp. n.). **61**, Itatiaia National Park, 2400 m, Itatiaia, Rio de Janeiro (*A. itatiaia* sp. n.). **62**, São Joaquim National Park, 1600 m, Urubici, Santa Catarina (*A. variabilis* sp. n.).

Both of the new genera have a prominent tuft of piliform scales extending transversely over the eyes (Figs 16–19). This structure was first documented by Nielsen & Scoble (1986) for *Afrotheora* Nielsen & Scoble, 1986. They noted that the eye tuft occurs in a broad range of genera, including the southern Andean genera *Dalaca* and *Callipielus*. Although they referred to the absence of this feature in *Parapielus* and *Calada*, we have observed it in

Parapielus luteicornis (Berg, 1882) (Fig. 18) and *Calada fuegensis* Nielsen & Robinson, 1983 (CM pers. obs.). As recorded here for *Agripialus* **gen. n.**, the eye tuft scales in *Afrotheora* arise from the head capsule just below the antennal socket (illustrated by Nielsen & Scoble (1986, Fig. 18) for *Elhamma australasiae* Walker, 1856). This arrangement has also been documented in *Hepialiscus* Hampson, [1893] (Fig. 19) (Mielke & Grehan 2016a), a genus endemic to Southeast Asia. In *Druceiella* Viette, 1949 the eye tuft scales emerge from the narrow region between the base of the antenna and the eye margin and were referred to as interocular scales (Grehan & Rawlins 2016). The same condition is found in *Mutipialus* **gen. n.** and *P. luteicornis*. Detailed studies of the scale morphology as well as the point of origin for the eye tuft scales is required to determine whether there are morphological features that may be phylogenetically informative.

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