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A new genus and a new species of railroad-worm beetle from Peru (Coleoptera, Phengodidae, Mastinocerinae)

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Abstract. Here I describe a new genus, *Iviephengus* gen. nov., based on a single species, *Iviephengus ferreirai* gen. et sp. nov., from Peru. This new genus is characterized by the following combination of characters: interantennal distance close to 3 × the antennal socket length; antenna 12-segmented, IV to XI each with two long symmetrical compressed and apically slightly enlarged branches; labrum fused to frontoclypeus; mandibles short, obliquely crossed, each with a notch on the external margin to fit the other mandible and without extra teeth; maxillary palpi 4-segmented, last segment digitiform; labial palpi 2-segmented; posterior tentorial pit consisting of a single small fossa; wing with radial cell closed and transverse, vein r4 interrupted, r3 absent; first tarsomere of pro- and mesotarsus with a ventral comb covering the posterior half of the tarsomere; claws simple, without any teeth; aedeagus with paramere symmetrical, apex unevenly round, toothed inward, with short and sparse bristles. I provide a key to Mastinocerinae genera with 12-segmented antennae and the first pro- and mesotarsomere with ventral combs. I also provide illustrations for the diagnostic features for this new genus. Finally, I discuss the presence and function of some modifications in the mandible and the sternite VIII in Phengodidae and other Coleopteran families.

Keywords. Amazon, Malaise trap, morphology, Neotropical, taxonomy.

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Introduction

The family Phengodidae LeConte, 1861 is composed of 304 species and 40 genera in the New World (from southern Canada to central Chile–Argentina) and in the Levant and Asia Minor (Costa & Zaragoza-Caballero 2010; Constantin 2014, 2016; Zaragoza-Caballero & Pérez-Hernández 2014; Roza *et al.* 2017, 2018; Kundrata *et al*. 2019; Roza & Mermudes 2019, 2020; Vega-Badillo & Zaragoza-Caballero 2019; Vega-Badillo *et al.* 2020, 2021a, 2021b). Currently, Phengodidae has four subfamilies: Cydistinae Paulus, 1972, distributed in Levant, Asia Minor and Iran (Kundrata *et al.* 2019), and Mastinocerinae

LeConte, 1881, Penicillophorinae Paulus, 1974 and Phengodinae LeConte, 1861, distributed in the Americas (Zaragoza-Caballero & Pérez-Hernández 2014). The three American subfamilies are most likely artificial groups, and the family is in need of a classification framework based on a more robust phylogenetic hypothesis (Zaragoza-Caballero & Zurita-García 2015; Quintino 2017).

The taxonomic knowledge of the family is still incipient, and the taxonomic impediment is a reality for the majority of taxa. Only two genera were ever revised – *Zarhipis* LeConte, 1881 and *Cenophengus* LeConte, 1881 (Linsdale 1964; Vega-Badillo *et al.* 2021a). Additionally, four new genera and several new species have been described in the last five years alone (Roza *et al.* 2017, 2018; Roza & Mermudes 2019, 2020; Vega-Badillo *et al.* 2020). Here, I describe a new genus and a new species, based on specimens from the Peruvian Amazon. I also provide a distributional map and a key to distinguish the new genus from morphologically similar taxa.

Material and methods

All specimens were collected using Malaise traps, glued to a triangular card and pinned. Specimens were deposited at the Museo de Historia Natural de la Universidad Mayor de San Marcos, Lima, Peru (MUSM), Coleção Entomológica Prof. José Alfredo Pinheiro Dutra, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (DZRJ) and Michael A. Ivie collection, Bozeman, Montana, USA (MAIC). The terminology follows Costa & Zaragoza-Caballero (2010) and Zaragoza-Caballero & Zurita-García (2015). For hind wings, I follow Lawrence *et al*. (2021).

Specimens with the abdomen dissected had their abdomen, terminalia and genitalia preserved in glycerine. Photographs and measurements were taken using a Leica DFC450 and Application Suite Cv3 Multifocus Software. The photographs were edited using Adobe Photoshop and the plates were designed with Adobe Illustrator (Adobe Systems). Total length is calculated from the sum of lateral head, thorax and abdominal lengths (up to wing length only, to avoid distortions due to abdomen flexibility), because extracting only overall body size could be misleading due to pronotal and head declination. Specimens were cleaned with ultrasonic sound for scanning electron microscopy (SEM), which was made with a Carl Zeiss, FEG Sigma 300 VP, at the Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil.

Results

Class Insecta Linnaeus, 1758
Order Coleoptera Linnaeus, 1758
Superfamily Elateroidea Leach, 1815
Family Phengodidae LeConte, 1861
Subfamily Mastinocerinae LeConte, 1881

Key to the identification of Mastinocerinae genera with 12-segmented antennae and the first pro- and mesotarsomere with ventral combs

Adapted from Zaragoza-Caballero & Pérez-Hernández (2014), with modifications on couplet 16 and the addition of a new couplet. The key is presented here starting at couplet 12, which includes the Mastinocerinae with 12-segmented antennae and first pro- and mesotarsomere with ventral combs.

12. Only the first pro- and mesotarsomere with ventral combs 13

13. Mandibles without internal teeth 14
13'. Mandibles with internal teeth .....***Pseudomastinocerus*** Wittmer, 1963

14. Posterior pronotal margin continuous 15
14'. Posterior pronotal margin discontinuous, with medial region projected ..... ***Phrixothrix*** Olivier, 1909

15. Antennomere IV–XI with double flabellae 16
15'. Antennomere IV–X with double flabellae, XI enlarged and without flabellae ..... ***Eurymastinocerus*** Wittmer, 1976

16. Tarsal combs as long as tarsus 17
16'. Tarsal combs as long as half of tarsus 16a

16a. Labial palpi 2-segmented, tarsomere II as long as half of tarsomere I length ..... ***Iviephengus*** gen. nov.
16a'. Labial palpi 3-segmented, tarsomere II subequal to tarsomere I length ..... ***Cephalophrixothrix*** Wittmer, 1976

17. Tarsal claws simple, without teeth 18
17'. Tarsal claws with thin teeth on claw base ..... ***Ptorthodius*** Gorham, 1881

18. Labial palpi 3-segmented 19
18'. Labial palpi 2-segmented ..... ***Mastinomorphus*** Wittmer, 1976

19. Two large and uneven tentorial pits, clypeus not projected, labrum dorsally visible ..... ***Mastinocerus* (*Mastinocerus*)** Solier, 1849
19'. A single tentorial pit, clypeus projected, labrum not visible dorsally ..... ***Mastinocerus* (*Paramastinocerus*)** Wittmer, 1976

Genus ***Iviephengus*** gen. nov.
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Figs 1–5

Type species

Iviephengus ferreirai gen. et sp. nov., here designated.

Diagnosis

Interantennal distance close to 3× the antennal socket length (Figs 1D, 2A); antenna 12-segmented, IV to XI each with two long symmetrical compressed and apically slightly enlarged branches, longer than respective antennomere (Fig. 2G); labrum fused to frontoclypeus (Fig. 2A); mandible short, not projecting and obliquely crossed, each with a notch on the external margin to fit the other mandible and without extra teeth (Fig. 2H–I); maxillary palpi 4-segmented, last segment digitiform (Fig. 2J); labial palpi 2-segmented (Fig. 2K); posterior tentorial pit consisting of a single small fossa (Fig. 2B); elytron around 2.5× longer than wide, slightly convergent posteriorly and slightly thickened apically (Fig. 1A); wing with radial cell closed and transverse, vein r4 interrupted, r3 absent (Fig. 1E); first tarsomere of pro- and mesotarsus with a ventral comb covering the posterior half of the tarsomere (Fig. 3A–B); claws simple, without any teeth (Fig. 3C); aedeagus with paramere symmetrical, apex unevenly round, toothed inward, with short and sparse bristles (Fig. 4D, G–H).

Etymology

The name is in honour of the entomologist Michael Ivie, a great Coleoptera researcher who has contributed largely to the knowledge of world beetles, including phengodids, with a major focus on morphology and

taxonomy. Michael kindly received me during my visit to the Montana State University and allowed the loan of several Phengodidae specimens. The suffix *phengus* is found in several Phengodidae genera. Singular genitive, masculine.

Description

Male

Head (Figs 1D, 2). Head wider than long, with posterior margin subparallel, slightly convergent posteriorly, usually covered by pronotum, as wide as the pronotum; antenna slightly longer than elytron; 12-segmented, antennomeres IV–XI with two symmetrical compressed and apically slightly enlarged branches, longer than respective antennomere (Fig. 2G); eyes moderately protruding, finely faceted (Fig. 2A–F), frontoclypeus with a declivity between the antennae before labrum, interantennal space close to 3 × antennal socket width; labrum small, fused with frontoclypeus but with vestigial lateral sutures, bilobate (Fig. 2A); mandibles moderately long, continuously tapered towards the apex, around 4 × longer than basal width, slightly projected and obliquely crossed, with an external notch to fit the other mandible (Fig. 2H–I); maxilla with palpi 4-segmented, last palpomere digitiform, palpifer distinct, galea distinct, extremely short and free, highly setose, lacinia almost fused with the stipe, highly setose, cardo semitriangular, 2 × as wide as long (Fig. 2J); labium with palpi 2-segmented, short, not covered by mandibles, last palpomere digitiform, ligula absent, prementum oval, palpiger absent, mentum and submentum fused in a single piece, which is fused with the head (Fig. 2K); one gular suture, tentorial pit with single fossa (Fig. 2B).

Thorax (Figs 1A–D, 3). Pronotum trapezoidal, slightly wider than long, anterior angles dorsally concave, rounded, lateral margins subparallel, laterally curved down in the anterior angles (Fig. 1D); elytron surpassing the fourth abdominal segment, around 2.5 × as long as wide, wider in anterior half, slightly convergent posteriorly, subparallel, apex slightly swollen (Fig. 1A); posterior wings with radial cell closed, moderately elongated and transverse, around 2.5 × as wide as long, r4 interrupted both in the radial cell and RP, r3 absent, RP reaching one third of MP1+2 length, medial field containing five main veins: MP3, MP4, CAS and AA4; CuA1 and CuA2 absent, anal lobe well developed, AP3+4 long, J absent (Fig. 1E); legs increasing in length from proleg to metaleg, pro- and mesotarsomere I with a ventral comb covering the posterior half of the tarsomere (Fig. 3A–B), protarsomere I 2 × as long as II, II–IV decreasing in length, tarsomere IV of all legs with ½ V length, claws simple, without any teeth (Fig. 3C).

Abdomen (Fig. 4). Subparallel, tergites and ventrites extremely transverse, around 3–4 × as wide as long, slightly increasing in length from the first to the last, tergite VIII as wide as long; tergites with anterior margin slightly emarginate, lateral margins subparallel, posterior margin straight to slightly rounded (Fig. 4A); tergite IX transverse, with a membranous division in the middle, anterior margin oblique inward, posterior margin curved inwards; tergite X short, conical, lateral margins subparallel (Fig. 4E); sternites each with anterior margin straight, lateral margins subparallel, posterior margin straight to slightly rounded (Fig. 4B), sternite VIII with a membranous, densely setose projection on anterior margin (Fig. 4C), sternite IX elongate, posterior margin slightly emarginate (Fig. 4F); aedeagus trilobed, basal piece attached to the median lobe, feebly sclerotized, and shaped as a ribbon-like stripe, median lobe cylindrical, strongly curved at base, rounded apically; flagellum encircled around median lobe at rest; about 2 × as long as median lobe length; parameres symmetrical, narrowing slightly past the middle towards the apex, which is truncate, toothed inward, with short and sparse bristles (Fig. 4D, G–H).

Female and immature stages

Unknown.

Biology and distribution

No specimens of *Iviephengus* gen. nov. were seen alive, so there is no data regarding their habits. The genus is only known to occur in the Peruvian Amazon. All specimens were collected in March, the end of the summer in the southern hemisphere.

Remarks

Iviephengus gen. nov. can easily be separated from most of the genera of Mastinocerinae by the presence of a ventral comb in the pro- and mesotarsomere I. When compared with other genera with combs on pro- and mesotarsomere I, it can be separated from all of them, with the exception of *Cephalophrixothrix* Wittmer, 1976, by the comb covering half of the ventral pro- and mesotarsomere I (vs covering the entire

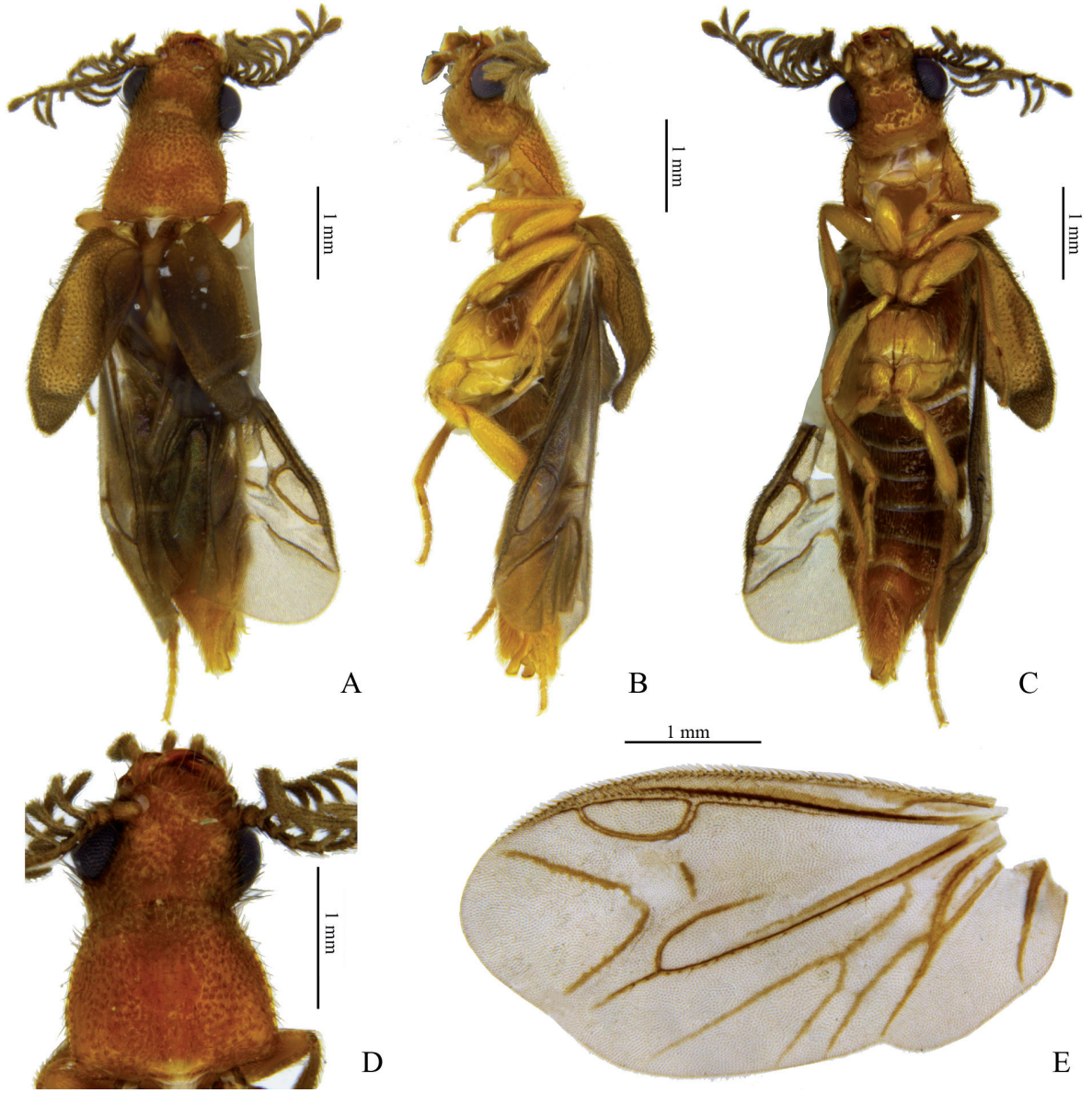

Fig. 1. *Iviephengus ferreirai* gen. et sp. nov. **A–D**. Holotype, ♂ (MUSM). **A**. Habitus, dorsal. **B**. Habitus, lateral. **C**. Habitus, ventral. **D**. Head and pronotum, lateral. **E**. Paratype, ♂ (DZRJ). Posterior wing, dorsal.

ventral pro- and mesotarsomere I in the other genera). It can be differentiated from *Cephalophrixothrix* by the mandible with a notch on the external margin to fit the other mandible (vs without a notch in *Cephalophrixothrix*), the labial palpi with two palpomeres (vs three in *Cephalophrixothrix*), and the tarsomere II half the length of tarsomere I (vs subequal to tarsomere I length in *Cephalophrixothrix*).

Iviephengus ferreirai gen. et sp. nov.
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Figs 1–5

Diagnosis

Body overall yellowish brown, with meso- and metanotum, anterior half of metasternum, and abdominal tergites and ventrites dark brown (with the exception of the last two) (Fig. 1A–C). Eyes occupying about 1/5 of head width in dorsal view; in lateral view, posterior margin vertical, slightly reniform (Fig. 2D). Antennomere IV length subequal to III, crescent until X, X–XII decrescent (Fig. 2G). Pronotum slightly wider than long, anterior margin straight, posterior margin slightly curved (Fig. 1D). Elytron 2.5× as long as wide (Fig. 1A).

Etymology

The species name is given in honour of Vinicius S. Ferreira, a good friend and fellow Coleoptera researcher (Lycidae specialist). Vinicius received me during my visit to MAIC and guided my search through the available material. Vinicius also has contributed to my research through collaborations, discussions, and other contributions. Singular genitive, masculine.

Type material

Holotype

PERU • ♂; San Martín, 30 km S of Picota; 6–16 Mar. 2005; M.E. Irwin leg.; Malaise trap; PE11-02; MUSM.

Paratypes

PERU • 2 ♂♂; same collection data as for holotype; DZRJ • 13 ♂♂; same collection data as for holotype; MAIC.

Type locality

Picota, San Martín, Peru.

Description

Male

Measurements (n = 13). Total length: 3.3–3.8 mm (aver. 3.6 mm). Head length: 0.63–0.68 mm (aver. 0.66 mm). Head width: 0.80–0.90 mm (aver. 0.87 mm). Pronotum length: 0.77–0.84 mm (aver. 0.80 mm). Pronotum maximum width: 0.93–0.96 (aver. 0.95 mm). Elytron length: 1.61–1.64 mm (aver. 1.63 mm). Elytron maximum width: 0.62–0.65 mm (aver. 0.64 mm).

Morphology. Head slightly wider than long, integument glossy, smooth, coarsely punctate, eyes small, feebly protruding, occupying 1/5 of the width in dorsal view (Figs 1D, 2A) post-ocular area subequal to eye length in lateral view, posterior margin straight, slightly reniform (Fig. 2D); antennomere IV length subequal to III, progressively longer from IV to X, X–XII decrescent, XII slightly lanceolate, antennomere IV flabellae 4× as long as antennomere body (Fig. 2G); maxilla with last palpomere as long as the three preceding ones (Fig. 2J); labium with last palpomere five times longer than the first one (Fig. 2K). Pronotum slightly wider than long, integument glossy, smooth, coarsely punctate, anterior

margin straight, lateral margins dorsally subparallel, posterior margin slightly curved (Fig. 1D). Elytron heavily setigerous punctate, around 2.5× as long as wide (Fig. 1A). Posterior wings with venation as in the genus description (Fig. 1E). Tergite IX transverse, 3× as wide as long in the middle line; tergite

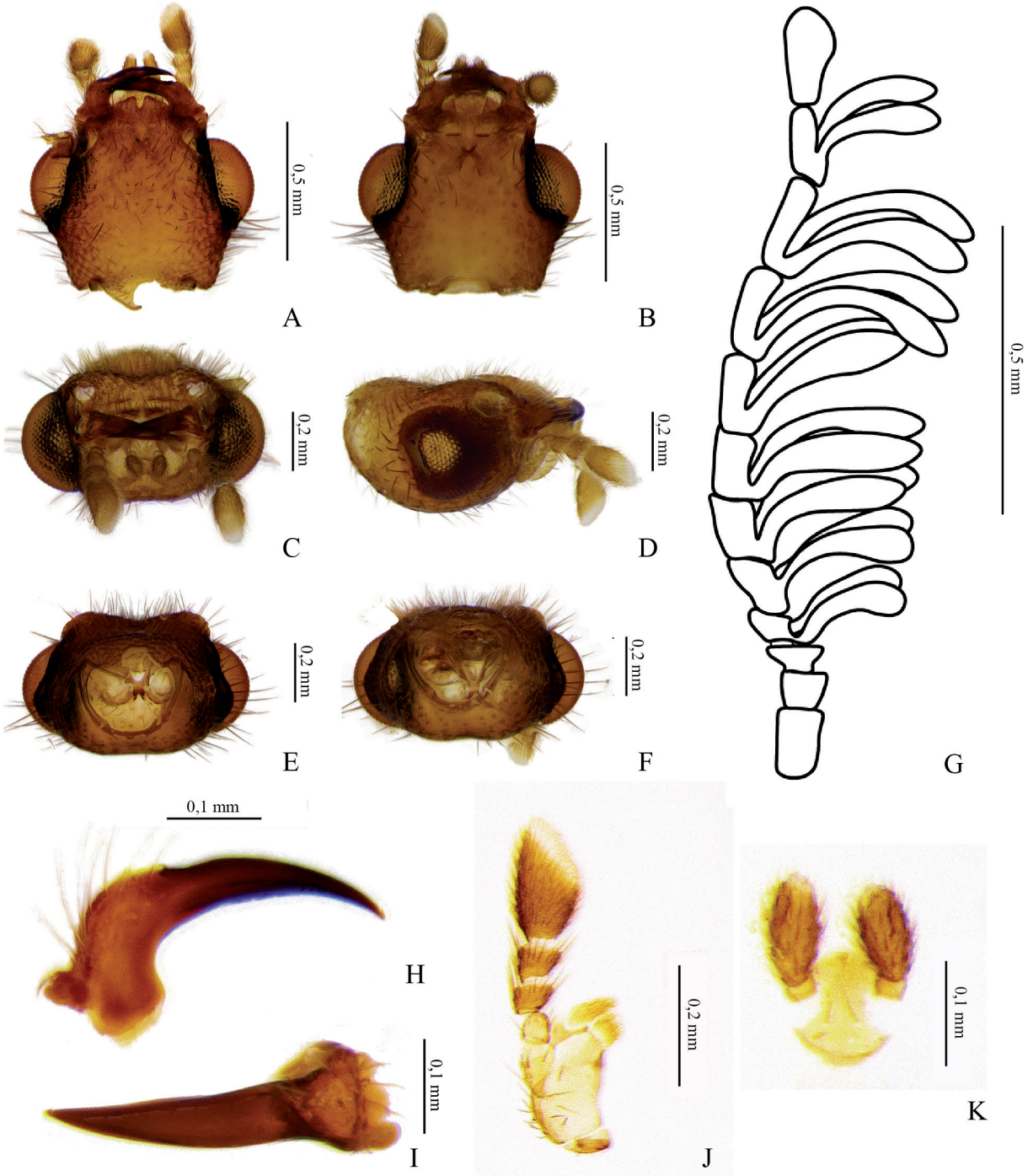

Fig. 2. *Iviephengus ferreirai* gen. et sp. nov., paratype, ♂ (DZRJ). **A**. Head, dorsal. **B**. Head, ventral. **C**. Head, frontal. **D**. Head, lateral. **E**. Head, posterior. **F**. Head, occipital. **G**. Antenna, lateral. **H**. Left mandible, dorsal. **I**. Left mandible, frontal. **J**. Maxilla, ventral. **K**. Labium, ventral.

X 1.5 × as long as wide (Fig. 4E). Sternite VIII with posterior margin slightly curved (Fig. 4C); sternite IX 2 × times as long as wide when including membranous area, posterior margin slightly emarginate (Fig. 4F). Aedeagus as in the genus description (Fig. 4D, G–H).

Coloration. Body overall yellowish brown, with meso- and metanotum, anterior half of metasternum, and tergites and ventrites dark brown (with the exception of the last two).

Immatures and females

Unknown.

Biology and distribution

Iviephengus ferreirai gen. et sp. nov. is only known to occur in the Peruvian Amazon (Fig. 5). All specimens were collected in March, the end of the Summer in the southern hemisphere. Specimens were never seen alive, so there is no data regarding their habits.

Discussion

Phengodid species may present very narrow (e.g., *Cleidella* Roza & Mermudes, 2020, *Akamboja* Roza, Quintino, Mermudes & Silveira, 2017, *Microphrixothrix* Roza & Mermudes, 2019) to broad (e.g., *Phengodes* Illiger, 1807) geographic ranges (Zaragoza-Caballero & Pérez-Hernández 2014). Revisionary studies are lacking for most genera, and hence the true geographic ranges of their species are unknown.

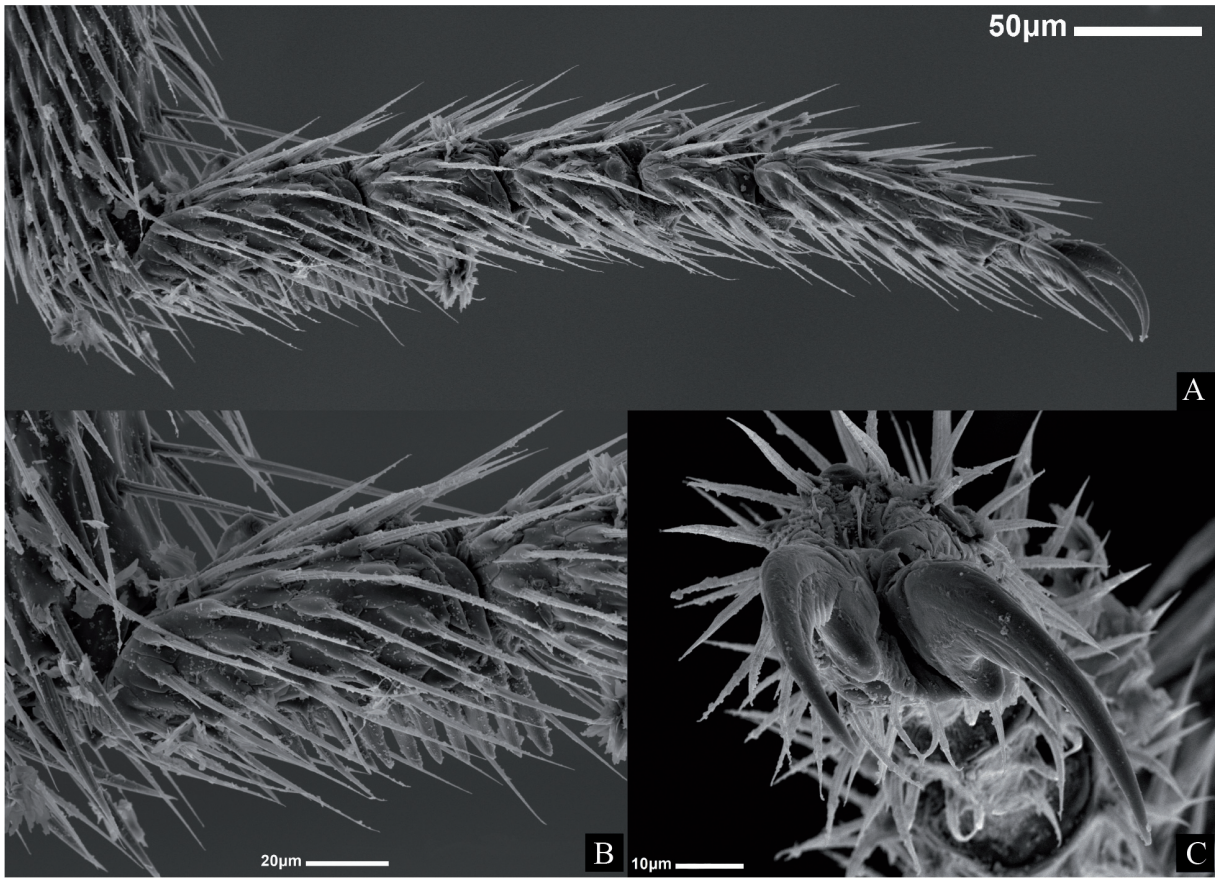

Fig. 3. *Iviephengus ferreirai* gen. et sp. nov., paratype, ♂ (DZRJ). Scanning electron micrographs. **A**. Protarsus, lateral. **B**. Protarsus, protarsomere I, comb, ventral, detail. **C**. Protarsus, claw, frontal.

Iviephengus gen. nov. is only known from the end of the summer in the Picota Province in Peru, but all specimens of *Iviephengus ferreirai* gen. et sp. nov. were collected from a single Malaise trap sample, on a single expedition. Therefore, the question of whether the species is endemic to the Picota Province region, and whether it occurs only at the end of summer, cannot yet be answered. It is worth mentioning,

Fig. 4. *Iviephengus ferreirai* gen. et sp. nov., paratype, ♂ (DZRJ). **A**. Abdomen, dorsal. **B**. Abdomen, ventral. **C**. Sternites VII and VIII, ventral. **D**. Aedeagus, lateral. **E**. Tergites IX and X, dorsal. **F**. Sternite IX, ventral. **G**. Aedeagus, dorsal. **H**. Aedeagus, ventral.

however, that the first author has visited several collections and received loans that contained phengodid beetles from Peru. So far, the type series of *Iviephengus ferreirai* represents the only specimens known for the genus. Therefore, the species may show spatially or temporally restricted occurrence.

There are two interesting characteristics presented by *Iviephengus* gen. nov. First, the mandibles possess an external notch to fit the other mandible when closed. Although described in Phengodidae for the first time in the genus described herein, this notch is present in several other genera (e.g., *Eurymastinocerus* Wittmer, 1976, *Euryognathus* Wittmer, 1976, *Microphrixothrix* Roza & Mermudes, 2019, *Nephromma* Wittmer, 1976 – pers. obs.). Mandible notches are found in other beetle families, such as Carabidae Latreille, 1802 (e.g., *Badister* Clairville, 1806) and Staphylinidae Latreille, 1802 (*Oxyporus* Fabricius, 1775 and *Cephennium* Müller & Kunze, 1822). In *Badister* and *Oxyporus*, however, the notch is in the dorsointernal margin of either right or left mandible (sometimes varying within the same species) to fit the other closed mandible (Cai *et al.* 2017; Hayashi & Sugiura 2021). In *Cephennium*, both mandibles are notched in the anterodorsal margin to fit the lateral portions of the labrum (Jałoszyński & Olszanowski 2016). The notch seems to be associated with the feeding habits of each of these genera. As male adult phengodids presumably do not feed (Costa & Zaragoza-Caballero 2010; Zaragoza-Caballero & Pérez-Hernández 2014), the function of the mandible notch is not clear. Additionally, a notch on the external margin of both mandibles, which can be indiscriminately closed over the other, does not seem to be present in any other Coleoptera family.

The second structure is a membranous and densely setose projection on the anterior margin of sternite VIII. A similar structure was already described for *Distremocephalus* Wittmer, 1976, which

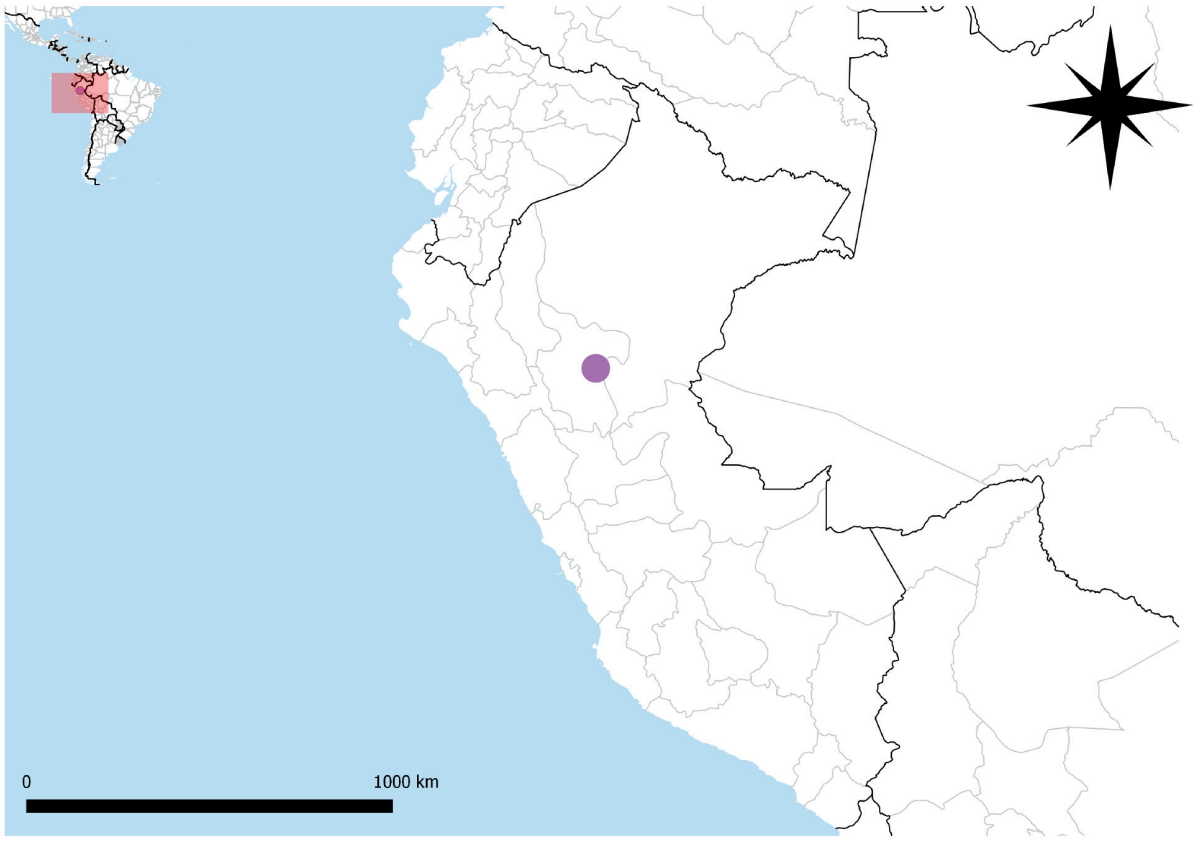

Fig. 5. Distribution (type locality) of *Iviephengus ferreirai* gen. et sp. nov.

has setose foveae on sternites VI and VII (Zaragoza-Caballero 1984). However, the two structures do not seem to be homologous due to location (sternite VI and VII vs sternite VIII) and morphological (setose concave depression (fovea) vs membranous setose projection) differences. This projection is actually present in about half of genera of Mastinocerinae genera (pers. obs.) but was never previously described. Similar modifications in the sternites are possibly responsible for pheromone production in females of the dermestid *Trogoderma* Dejean, 1821 (Hammack *et al.* 1973). The function (of both the *Distremocephalus* setose fovea and the membranous setose projection described here) in short-lived males of phengodids is still unclear. Future histological and transcriptomic descriptions of the abdominal tissues may provide an answer about the function of these remarkable structures.

Acknowledgments

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