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ANIMAL SCIENCE

Redescription of the monotypic plant bug genus *Paraneella* and *Paraneella amazonica* Carvalho 1954, with a neotype designation (Heteroptera: Miridae).

EUGENIA MINGHETTI, SARA ITZEL MONTEMAYOR & PABLO MATÍAS DELLAPÉ

Abstract: The monotypic Neotropical eccritotarsine genus *Paraneella* Carvalho (Heteroptera: Miridae) and its only included species, *Paraneella amazonica* Carvalho 1954, are diagnosed and redescribed, and new characters for their recognition are provided, illustrated, and photographed. *Paraneella amazonica,* previously known from the type locality in Brazil, is reported for the first time from Ecuador. Because the holotype deposited at the National Museum in Rio de Janeiro was destroyed by fire, a neotype is designated. Carvalho placed *Paraneella* in the "*Neella-Neoneella* genus complex" based on its similarity with *Neella* Reuter. The only existing key to identify these genera had in its first couplet characters referring to males that are unknown for *Paraneella amazonica*. A new key based on a new set of characters, which are photographed and illustrated, is provided.

Key words: Brazil, Eccritotarsini, Ecuador, genera, key.

INTRODUCTION

The Bryocorinae, the fourth largest subfamily of Miridae (Schuh 2002–2013, Konstantinov et al. 2018, Henry & Menard 2020), is highly diversified in terms of morphology, ecology, evolutionary history, and agricultural relevance (Konstantinov et al. 2018). Among the five recognized tribes, Eccritotarsini is the most diverse (Schuh 2002–2013, Konstantinov et al. 2018), with 70 genera and more than 450 species recorded from the Neotropics (Ferreira et al. 2015).

Nearly all the Neotropical eccritotarsine species are known from their original descriptions, with most species known from only one or a few specimens and with little information about host plants and habits (Schuh 2002-2013, Konstantinov et al. 2018).

Paraneella amazonica Carvalho 1954, previously known from a single female collected in Estado do Amazonas, Brazil, has been mentioned a few times in the literature since its original description (Carvalho 1957, 1960, Carvalho & Froeschner 1987). The holotype of this species, deposited in the Carvalho collection in the National Museum in Rio de Janeiro (Museu Nacional, MNRJ), was destroyed by fire in 2018.

Carvalho (1960) placed *Paraneella* in the "*Neella-Neoneella* genus complex" and provided a key to separate this genus from *Neella* Reuter 1908, *Neoneella* Costa Lima 1942, *Proneella* Carvalho 1960, and *Adneella* Carvalho 1960. The first couplet of his key refers to male hemelytral characters, but no males of *P. amazonica* are known.

While studying the Heteroptera collection in the U. S. National Museum of Natural History,

in Washington, D.C. (USNM) a female of *P. amazonica* from Ecuador was discovered. For this study we redescribe the genus and the type species, including characters not used in the original description, provide photographs and illustrations of these characters, designate a neotype, extend the distribution of *P. amazonica,* and provide a key to the "*Neella-Neoneella* genus complex" based on a new set of characters.

MATERIALS AND METHODS

Photographs were captured using a digital camera (Micrometrics 391CU, 3.2 m) mounted on a Nikon SMZ1000 stereomicroscope. Multiple focal planes were merged using Micrometrics SE Premium4 software. Line drawings of the male genitalia and plates were made in Corel Draw X8. Genital structures were dissected under a stereomicroscope, cleared in an 85% lactic acid solution for 5 min, washed in distilled water, preserved in vials with glycerin and photographed in excavated portal with glycerin. Terminology for male genitalia follows Konstantinov (2003) and Menard & Schwartz (2018). The map was built using QGis 3.2, localities were georeferenced with Google Earth Pro. All measurements were taken from the specimens under a stereomicroscope and are given in millimeters.

RESULTS

Paraneella Carvalho 1954

Type species: *Paraneella amazonica* Carvalho 1954.

Paraneella Carvalho 1954: 100 (original description); Carvalho 1957: 119 (catalogue); Carvalho 1960: 49 (key); Carvalho & Froeschner 1987: 133 (list); Carvalho & Ferreira 1995: 477 (key); Schuh 2002-2013 (online catalog).

Diagnosis

This genus is recognized by the following combination of characters: prominent, sessile eyes (Fig. 1e), not surpassing the dorsal margin of the head; globose vertex (Fig. 1f); antennal segment I abruptly widened at the middle, and gradually widening on the distal half (Fig. 1e), and subequal in length to segment II; anterior pronotal lobe with convex lateral margins; strongly punctate collar and posterior pronotal lobe (Fig. 1e); and metafemur with the basal half strongly swollen and slightly curved over body (Fig. 1b-c).

Redescription

Surface and vestiture

Shiny. Collar and posterior pronotal lobe strongly punctate (Fig. 1e).

Head glabrous dorsally, with sparse, short, erect, golden setae ventrally. Labium with golden, semierect, long setae. Antennal segment I with a few recumbent setae. Antennal segments II, III and IV with abundant semierect setae, more profuse on antennal segments II and III. Hemelytra with abundant recumbent thin setae. Vein of membrane with a few short, golden setae. Pleural areas of thorax and abdominal sternites with semierect golden setae, longer than those on dorsum. Coxae, trochanters, and femora with abundant long semierect setae; femora ventrally with long, erect setae (Fig. 1c, g). Tibiae with abundant shorter, thicker, semierect setae. Tarsi with short semierect setae.

Structure

Head: vertical; almost two times wider than long. Clypeus prominent, rounded in lateral view, protruding basally, not visible from above. Front globose (Fig. 1f). Vertex strongly globose, exceeding dorsal margin of eyes (Fig. 1f-g), width 1.08 times head length and 1.5 times less

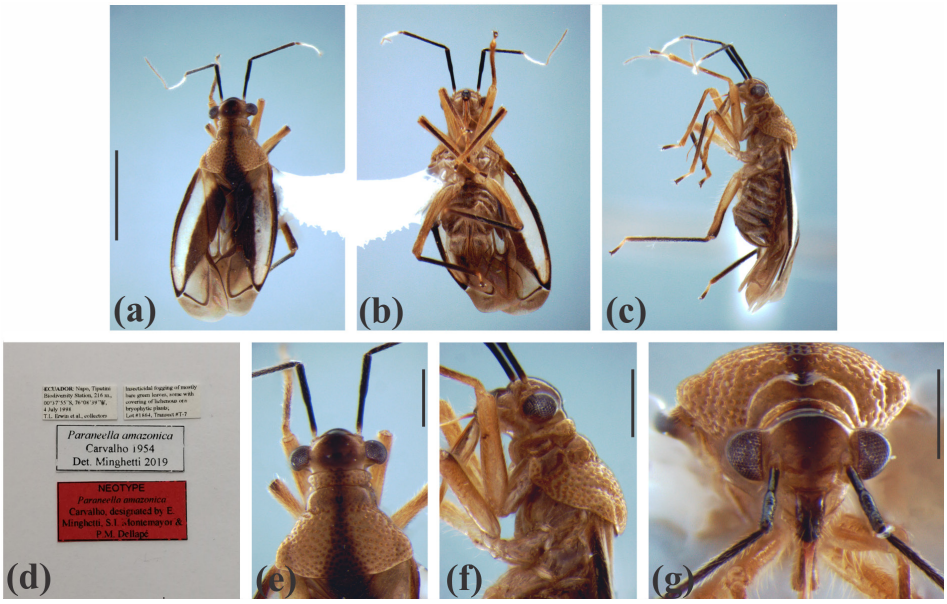

Figure 1. ***Paraneella amazonica*** **Carvalho 1954. Neotype female (a) dorsal view; (b) ventral view; (c) lateral view; (d) labels; (e) head and pronotum in dorsal view; (f) head and pronotum, lateral view; (g) head and pronotum, anterior view. Scale: (a): 1.5 mm; (e-g): 0.5 mm.**

than antennal segment I length (Fig. 1e). Eyes prominent, rounded, sessile, occupying less than half of head height; inner and posterior margins straight, inner margin at same level as lateral margin of collar (Fig. 1e). Mandibular plates large, wide, and rectangular. Labrum long (Fig. 1c), almost reaching the apex of labial segment I. Gula long. Labium: segments I and II longest, III and IV subequal. Antennae inserted at middle of eye height (Fig. 1f-g). Antennal segment I widened at middle, clearly differentiating a narrower basal half from a wider apical half (Fig. 1e). Antennal segment II uniformly wide, slender and slightly longer than antennal segment I (Fig. 1a). Antennal segment III narrow and tapering distally. Antennal segment IV uniformly wide, more slender than antennal segment III.

Thorax: collar with anterior and posterior margins straight. Pronotum bell-shaped, slightly declivent toward head; posterior margin width 1.5 times pronotum length. Anterior pronotal lobe with lateral margins convex, differentiated from and less than half the length of the posterior pronotal lobe (Fig. 1e-g). Calli large, attaining lateral margins of anterior pronotal lobe and contacting each other anteriorly and posteriorly on midline, with a median depression between them (Figs. 1e, g). Pronotal width across calli half of posterior margin width; discal area of posterior lobe raised, separated from humeral angles by a strong longitudinal depression (Fig. 1e); posterior margin straight over the scutellum (Fig. 1e). Mesoscutum exposed. Scutellum equilateral, with a central anterior depression. *Hemelytra:* flat in lateral view; lateral margins parallel. Embolium thin and flattened along posterior margin, wider basally. Medial fracture barely visible, adjacent to R+M vein, less than a half of corium length. R+M vein attaining cuneal fracture. Cuneal fracture evident, obliquely contacting embolium. Cuneus almost 1.5 times longer than basal width, weakly deflected. Membranal cell forming a rounded angle at middle of membrane beyond posterior margin of cuneus, 2.42 times longer than wide. *Legs:* femora widened on basal half (Fig. 1b-c); metafemora slightly curved over the body (Fig. 1b). Tibiae slender, cylindrical, and of uniform width, except distal end of protibiae thickened and flattened on inner side.

Male: unknown.

DISCUSSION

When Carvalho (1954) described the genus *Paraneella*, he suggested a relationship with *Neella* and mentioned the length and shape of antennal segment I, the shape and pubescence of posterior femora, and the shape and size of the scutellum as characters to distinguish them. In species of *Neella* antennal segment I is not tapered on the basal half and is much shorter than antennal segment II, the scutellum is longer than half the length of the claval commissure, and the metafemora are only slightly widened basally. A similar set of characters are used in the key to the *Neella-Neoneella* complex (Carvalho 1960), adding the fine pronotal punctation as another difference with *Neella* species.

Both genera differ from the other genera in the complex by the similar length of the labium attaining at least the mesocoxae, the posterior margin of eyes with an internal curvature, the clypeus not visible from above, and the cuneus about two times longer than the basal width.

Paraneella amazonica Carvalho 1954

Paraneella amazonica Carvalho, 1954: 100-101 (n. sp.; fig.). [Female holotype in MNRJ, destroyed by fire]; Carvalho, 1957: 119 (catalogue); Schuh 2002-2013 (online catalog)..

Diagnosis

This species is recognized by the dark brown or black and yellow coloration (Fig. 1a); head dorsally, collar, and pronotum glabrous (Fig. 1e-g); antennal segment I with a few recumbent setae; labrum almost reaching the apex of labial segment I; gula long; labium attaining metacoxae (Fig. 1c); scutellum half length of the claval commissure, claval commissure shorter than pronotum; internal margin of cuneus sinuate; and membranal cell with internal margin slightly convex and posterior margin with slight concavity before contacting cuneus (Fig. 1a).

Redescription

Female (n=1): total length (from anterior end of clypeus to posterior margin of membrane) 3.76 mm; length from anterior end of clypeus to posterior margin of cuneus 3.34 mm. *Head:* Width across eyes 0.84 mm; interocular distance 0.48 mm. *Labium:* Segment I length 0.48 mm; II, 0.43 mm; III, 0.24 mm; IV, 0.19 mm. *Antenna:* Segment I length 0.72 mm; II, 0.84 mm; III, 0.55 mm; IV, 0.64 mm. *Pronotum:* Median length 0.79 mm; anterior width 0.59 mm; posterior width 1.19 mm. *Scutellum:* length 0.36 mm; width 0.47 mm. *Cuneus:* length 0.62 mm; basal width 0.42 mm.

Coloration

Head: pale yellow. Vertex and middle of frons dark brown. Clypeus dark brown to black. Mandibular plates, maxillary plates, and bucculae pale yellow. Labrum pale yellow, anterior margin brown. Labium pale yellow with apex dark brown. Antennal segment I black; II black, with a thin, reddish basal ring; III whitish with apices brown; IV brown. Thorax: collar and calli pale yellow, dark brown centrally; posterior pronotal lobe pale yellow with longitudinal median line dark brown, widening toward posterior margin. Mesoscutum pale yellow, black centrally. Propleura, mesepisternum, mesepimeron and ostiolar peritreme pale yellow. *Hemelytra* embolium pale brown, with outer margin black; R+ M vein black; corium pale yellow on outer half and dark brown on inner half; clavus pale yellow anteriorly and dark brown on posterior half; cuneus pale yellow except inner and outer margins brown; membrane smoky brown, more translucent inside areole and along distal margin; veins dark brown. *Legs:* coxae and trochanters pale yellow. Profemora pale yellow; mesofemora pale yellow, with a triangular, pale

brown macula distally; metafemora pale yellow, distal half dorsally dark brown. Protibiae pale yellow, basal half of external surface brown; mesotibiae dark brown, distal third pale yellow; metatibiae dark brown. Pro- and mesotarsus pale yellow; metatarsus dark brown. Claws dark brown. Abdomen: pale yellow.

SURFACE AND STRUCTURE: as genus.

HOST PLANT: unknown.

DISTRIBUTION: Brazil, Ecuador (Fig. 2).

Material Studied

Holotype ♀ (photographs): BRAZIL: Amazonas: Río Itacoaí, VI-50, JCM Carvalho col., 237, MNRJ-ENT3-800, *Paraneella amazonica* n. g., n. sp. J. C. M. Carvalho det. 1953 (MNRJ) [destroyed in the 2018 fire].

To ensure nomenclatural stability and accurate identification of *Paraneella amazonica*, which holotype was destroyed in the MNRJ fire, we are designating the following female deposited in the USNM as a neotype: [Label 1] ECUADOR: Orellana Prov. [as Napo Prov.], Tiputini Biodiversity Station, 216m, 00°37´55”S 76°08´39”W, 4 July 1998, T. L. Erwin et al. collectors; [Label 2] Insecticidal fogging of mostly bare green leaves, some with covering of lichenous or bryophytic plants; Lot #1864, Transect # T-7; [Label 3] *Paraneella amazonica* Carvalho 1954 Det. Minghetti 2019; [Label 4] Neotype: ♀, *Paraneella amazonica* Carvalho, designated by E. Minghetti, S.I. Montemayor & P.M. Dellapé.

According to the official announcement from the Department of Entomology (Museu Nacional, Universidade Federal do Rio de Janeiro) on

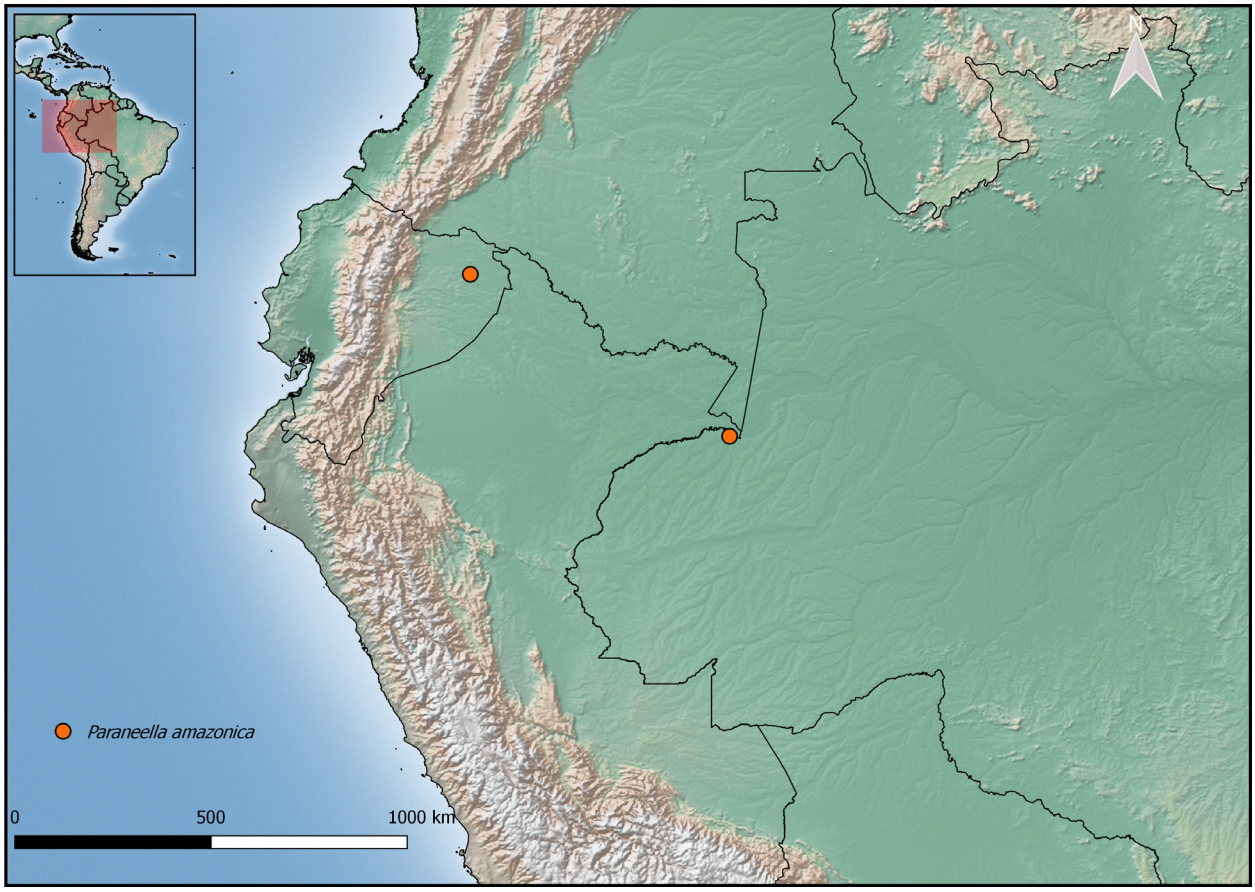

Figure 2. Distributional map of *Paraneella amazonica* Carvalho 1954.

the fire at the São Cristóvão Palace, the whole area in which the Entomological Collection was located was destroyed by fire, with only a single entomological laboratory that was not affected that houses part of the Diptera collection

Fortunately, some images of the types destroyed remain as part of a project still unpublished about the type material of Heteroptera at MNRJ. We were able to study dorsal photographs of the holotype of the species, that agrees completely with the specimen we are designating as Neotype here.

DISCUSSION

Paraneella amazonica, the only species assigned to the genus, was described based on a single female collected at the Itacoai River margins, near its confluence with Japari River, in Amazonas State, Brazil. The neotype from Orellana Province extends its distribution to the northwest and Ecuador represents a new country record.

Although males are unknown, characters exhibited by the female allow the recognition of the species and its differentiation from species in related genera.

Key to the genera of the *Neella-Neoneella* complex

1. Antennal segment I wider at middle, with basal half narrower than apical half. Pronotum shiny, glabrous, and strongly punctate. Anterior pronotal lobe with lateral margins convex, differentiated from posterior pronotal lobe. Humeral angles of pronotum clearly separated from pronotal disc by strong longitudinal depression. Cuneal fracture shorter than width of embolium ... *Paraneella*

1´. Antennal segment I narrower at middle (Fig. 3a-c), with base and apex wider. Pronotum finely punctate and setose. Anterior pronotal lobe not clearly differentiated from posterior pronotal lobe. Humeral angles of pronotum not clearly separated from pronotal disc by shallow depression (Fig. 4). Cuneal fracture longer than width of embolium (Fig. 5) ... 2

2. Yellowish species, with reddish, orange, brown or black areas. Total length more than 6.35 mm. Vertex convex to globose, located higher than superior margin of eyes (Fig. 3d). Clypeus prominent, visible from above. Labium extending at most to middle of mesosternum. Posterior pronotal margin convex. Vein on membrane forming an angle beyond posterior

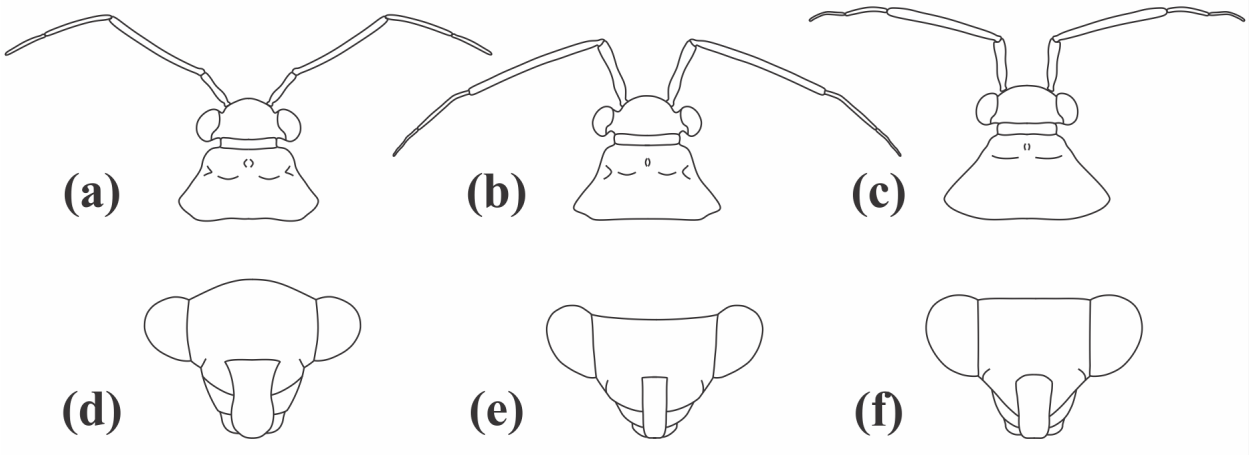

Figure 3. Head and pronotum. (a-c) dorsal view; (d-f) anterior view; (a) *Neella eucosma* (Stål 1862) Reuter 1908; (b) *Neoneella bosqui* Carvalho 1946; (c, f) *Proneella boliviana* Carvalho 1960; (d) *Adneella columbiensis* (Carvalho & Gomes 1971) Carvalho 1989; (e) *Neoneella zikani* Costa Lima 1942.

margin of cuneus (Fig. 4a). Genital capsule with supragenital bridge strongly sclerotized (Fig. 6a) ... *Adneella*

2´. Reddish or orange species, some with dark brown or black areas. Shorter, total length less than 6.3 mm, (except some *Neoneella* males, that can measure up to 7.6 mm, but easily distinguished by the morphology of cuneus). Vertex flat or concave, never surpassing dorsal margin of eyes (Fig. 3e-f). Clypeus not visible from above (Fig. 4b-d). Labium extending at least to mesocoxae. Posterior pronotal margin concave, straight, or slightly concave, and obliquely truncate at humeral angles. Vein on membrane forming an angle at posterior margin of cuneus (Fig. 4b-d). Genital capsule without sclerotized supragenital bridge ... 3

3. Without sexual dimorphism, cuneus equally developed in both sexes (Fig. 4b). Eyes slightly pedunculated, laterally directed, with wide peduncle and devoid of anterior and posterior concavity at its junction with the head. Antennal segment I length less than twice width of eye (Fig. 3a). Membrane cell length, in both sexes, less than 3.5 times width. Dorsal wall of genital capsule without sclerotizations (Fig. 6c) ... *Neella*

3´. With sexual dimorphism, cuneus more developed in males (Fig. 5). Eyes sessile or pedunculated with narrow peduncle directed posteriorly and with anterior and posterior concavity at its junction with the head. Antennal segment I length more than two times width of eye (except in *Proneella peruana* Carvalho 1960, but eyes are sessile) (Fig. 3b-c). Membrane cell

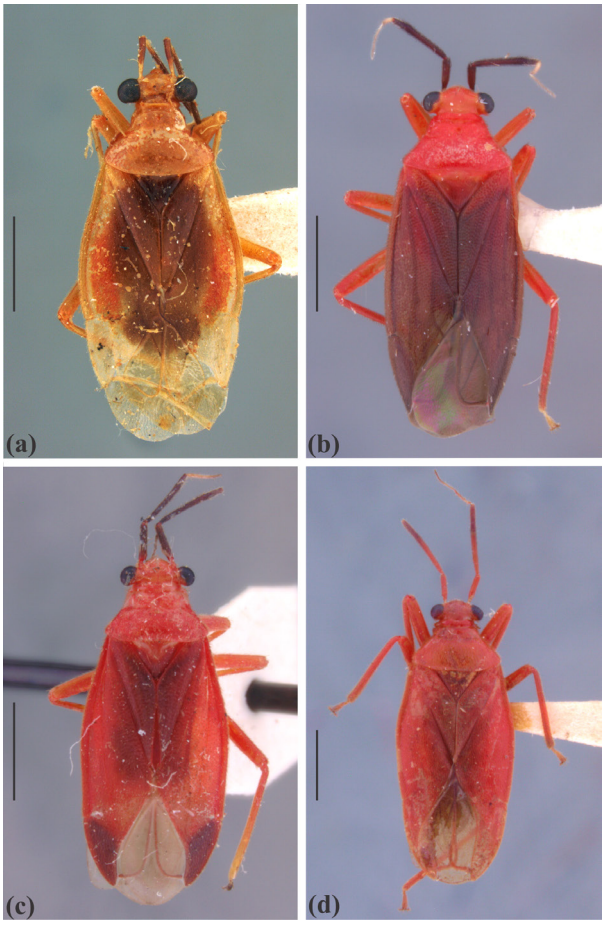

Figure 4. Dorsal view. **(a)** ***Adneella nigronotata*** (Carvalho 1954), male; **(b)** ***Neella eucosma*** (Stål 1862) Reuter 1908, female; **(c)** ***Neoneella zikani*** Costa Lima 1942, female; **(d)** ***Proneella boliviana*** Carvalho 1960, male. **Scale:** 1.5 mm.

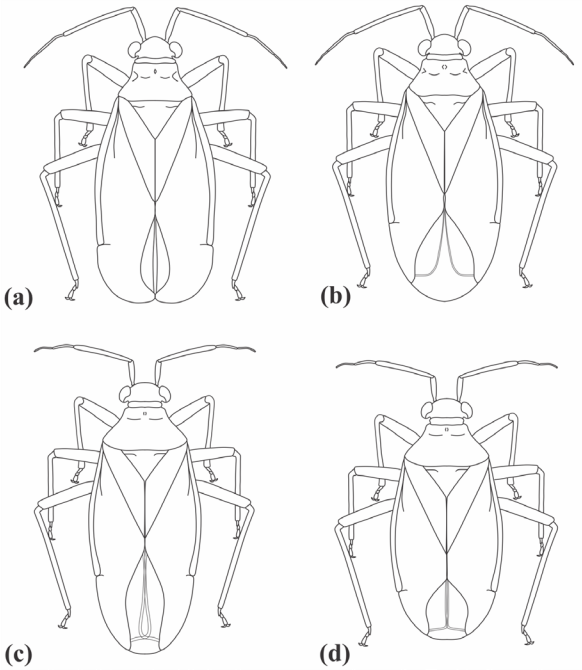

Figure 5. Dorsal view of ***Neoneella*** Costa Lima 1942 and ***Proneella*** Carvalho 1960. **(a-b)** ***Neoneella zikani*** Costa Lima 1942; **(c-d)** ***Proneella peruana*** Carvalho 1960; **(a, c)** male; **(b, d)** female.

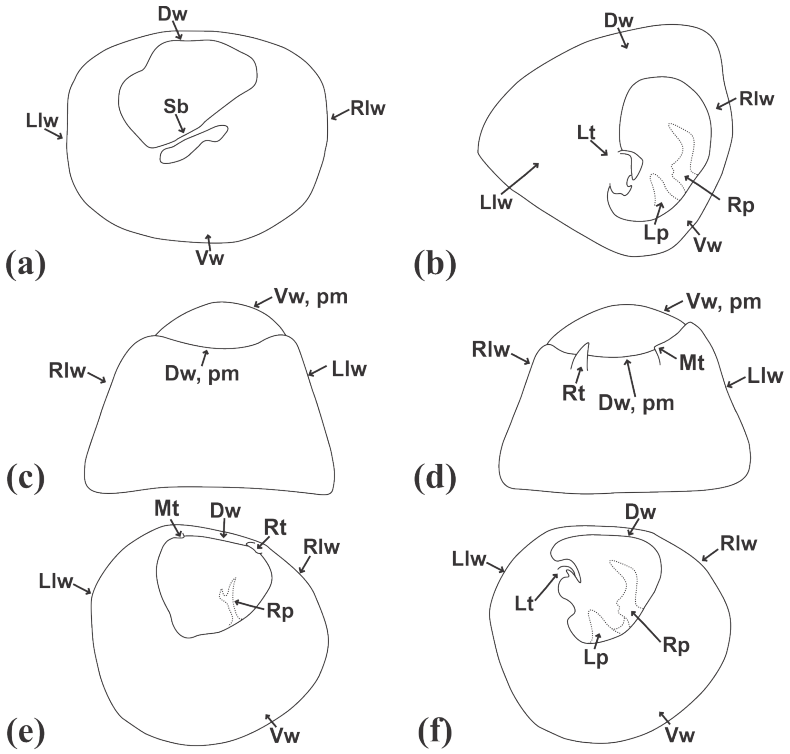

Figure 6. Schematic drawings of the genital capsule. (a, e-f) posterior view; (b) laterodorsal view; (c-d) dorsal view; (a) *Adneella osunai* Carvalho 1989; (d, e) *Neoneella bosqui* Carvalho 1946; (b, f) *Proneella boliviana* Carvalho 1960; (c) *Neella eucosma* (Stål 1862) Reuter 1908. Abbr. Dw: dorsal wall. Dw, pm: dorsal wall, posterior margin. Llw: Left lateral wall. Lp: Subgenital plate left process. Lt: sclerotized left tooth. Mt: sclerotized medial tooth. Rlw: right lateral wall. Rp: Subgenital plate right process. Rt: sclerotized right tooth. Sb: supragenital bridge. Vw: ventral wall. Vw, pm: ventral wall, posterior margin.

length, in both sexes, more than 3.5 times width. Dorsal wall of genital capsule with sclerotizations (Fig. 6b, d) ... 4

4. Eyes pedunculate, slightly directed up and backward. Inner margin of eyes exceeding outer margin of collar. Vertex concave, located below dorsal margin of eyes (Fig. 3e). Embolium flattened. Claval commissure more than 2 times the scutellum length. Cuneus in male well developed, attaining posterior margin of hemelytra and contacting each other with hemelytra resting. Membrane reduced, vein straight (Fig. 5a). Genital capsule without dorsal sclerotization or with tooth-shaped sclerotizations, but never on left margin (Fig. 6d). Subgenital plate with a process on right side (Fig. 6e) ... *Neoneella*

4´. Eyes sessile, inner margin of eye level with outer margin of collar. Vertex flat, located at same level of dorsal margin of eyes (Fig. 3f). Embolium rounded. Claval commissure less than 2 times scutellum length. Cuneus in male well developed, attaining posterior margin of hemelytra, but not contacting each other with hemelytra resting. Membrane not reduced. Membrane vein forming an angle in middle of the membrane (Fig. 5c). Genital capsule with two tooth-shaped sclerotizations, separated by a concavity, on left margin (Fig. 6b). Subgenital plate with processes on right and left sides (Fig. 6f) ... *Proneella*

Remarks

Label data from specimens photographed in figure 4: (a) *Adneella nigronotata* (Carvalho 1954) n. comb., male holotype, PERU: Iguapo, *Neella nigronotata* n. sp. J C M Carvalho det. 1953 (USNM); (b) *Neella eucosma* (Stål 1862) Reuter 1908, female, MEXICO: Oaxaca, 2.7 mi. nw. El Cameron, July 24, 1973, taken at light, Mastro & Schaffner, Carvalho to Drake coll. 1993, *Neella euscomus* (Stål) det. J. C. M. Carvalho 19 (USNM); (c) *Neoneella zikani* Costa Lima 1942, female, São Paulo Braz, No 907.5 Montevideo, So. Amer., Paras. Lab, date Jan 44, host *Philodendron*?, Parker (USNM); (d) *Proneella boliviana* Carvalho 1960,

male holotype, El Palmar, Chapere Cochabamba, BOLIVIA, 1000m, 10/18-I-1958, Monrós y Wygodzinsky, *Proneella bolivina* n. sp. det. JCM. Carvalho 19, USNMENT 01145334 (USNM).

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EUGENIA MINGHETTI[1,2]
https://orcid.org/0000-0002-9867-8121

SARA ITZEL MONTEMAYOR[1,2]
https://orcid.org/0000-0002-3159-0280

PABLO MATÍAS DELLAPÉ[1,2]
https://orcid.org/0000-0002-6914-1026

[1]Universidad Nacional de la Plata, División Entomología, Museo de La Plata, Paseo del Bosque s/n, B1900FWA, La Plata, Buenos Aires, Argentina

[2]CCT CONICET La Plata, Calle 8, N° 1467, B1904CMC, La Plata, Buenos Aires, Argentina

Correspondence to: **Eugenia Minghetti**
E-mail: eugeniaminghetti@fcnym.unlp.edu.ar

Author contributions

EM, SIM and PMD contributed equally to the preparation and writing of the manuscript. EM made the illustrations and distributional map.