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From "insect soup" to biodiversity discovery: taxonomic revision of *Peloridinannus* Wygodzinsky, 1951 (Hemiptera: Schizopteridae), with description of six new species

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Abstract

With only about 320 described species, Dipsocoromorpha is currently one of the smallest and least studied infraorders of Heteroptera (Hemiptera). Specimens are small (often 1 – 2 mm), live in cryptic habitats, are collected using specialized techniques, and curated material in natural history collections is scarce. Despite estimates of vast numbers of yet to be described species, species discovery and documentation has slowed compared to peak taxonomic activity in the mid-20th century. We show, using the genus *Peloridinannus* Wygodzinsky, 1951 (Hemiptera: Schizopteridae) as an example, that curating specimens from bulk samples already housed in natural history collections is an effective way of advancing our understanding of the biodiversity of this charismatic group of true bugs. *Peloridinannus* Wygodzinsky was described as a monotypic genus, known only from two female specimens from Costa Rica. Based on examination of 59 specimens from Costa Rica, Panama, Ecuador, and Peru, six new species of *Peloridinannus* are described, *Peloridinannus curly* sp.n., *Peloridinannus larry* sp.n., *Peloridinannus laxicosta* sp.n., *Peloridinannus moe* sp.n., *Peloridinannus sinefenestra* sp.n., and *Peloridinannus stenomargaritatus* sp.n. Further, males are documented for the first time for this genus. The holotype and paratype of *Peloridinannus margaritatus* Wygodzinsky are shown to belong to different species, and the paratype is transferred to *Peloridinannus stenomargaritatus* sp.n. Male and female genitalic characters, as well as wing venation and wing structure characters are documented using digital images including scanning and confocal micrographs. This taxonomic revision and morphological documentation will also provide a foundation for any future investigations into the enigmatic taxonomic position of *Peloridinannus* within the Schizopteridae.

Key words

Heteroptera, Dipsocoromorpha, Neotropical region, species discovery, taxonomic revision, morphology.

1. Introduction

At first glance Schizopteridae (Hemiptera: Dipsocoromorpha) are reminiscent of "little brown beetles": the ~250 worldwide described species are typically between 1 and 2 mm small and feature various shades of brown (Emsley 1969; Schuh & Slater 1995; Weirauch & Štys 2014). In addition, females in numerous species possess elytra where the hemelytra, that in Hemiptera typically comprise a sclerotized corium and a flexible membrane, are transformed into completely sclerotized and strongly curved elytra, giving the specimens a "coleopteroid" appearance (Wygodzinsky 1948; Emsley 1969; Hill 2013). Despite their small size that requires specialized curation and morphological documentation techniques, Schizopteridae feature stunning and still largely undocu-

mented morphological diversity, ranging from complex male genitalia involving modifications of the pre-genital abdomen (Wygodzinsky 1950) to a variety of unique structures on the head and thorax (*Corixidea* group of genera; unpublished data) including the hemelytron (e.g., "wing organs" in *Chinannus* Wygodzinsky, 1948 [Wygodzinsky 1948]). Schizopteridae live in cryptic microhabitats, such as leaf litter and top soil (Emsley 1969), with greatest diversity in the wet tropics. The majority of known specimens were collected using specialized passive collecting techniques rarely employed by hemipterists, including leaf litter extraction, yellow pan traps, and Malaise traps. It is therefore not surprising that the biodiversity of Schizopteridae is poorly documented at the species level.

Species discovery in the 21st century often involves travels to highly endemic areas and remote places. While this is an important avenue for the discovery of new taxa, we argue that species discovery for certain groups of invertebrates can be accelerated by focusing on already existing resources such as bulk or residue samples. These are samples that were collected often many decades ago using passive trapping techniques including litter extraction, and sorted for certain target taxa. These collections provide a virtually untapped biodiversity resource stored in natural history collections around the globe. The bulk sample collection at the Field Museum of Natural History (FMNH) http://www.fieldmuseum.org/node/5031 is one example. Schizopteridae are small and easily overlooked, and few systematists focus on this group. Many undescribed species are therefore waiting to be discovered in jars of "insect soup", i.e. the residues of trap samples.

Peloridinannus Wygodzinsky was described as a monotypic genus based on the female holotype of *Peloridinannus margaritatus* Wygodzinsky, 1951 from Costa Rica (Wygodzinsky 1951). A second, syntopic (i.e. reported from the same locality and collection event) female specimen was thought to be conspecific and designated as the paratype in the same publication. *Peloridinannus* stands out amongst other Schizopteridae by distinct wing venation with numerous cells that, in most species, feature small depressions known as "areoles" resulting in a superficial resemblance to moss bugs in the family Peloridiidae (Hemiptera: Coleorrhyncha). Other noteworthy features of *Peloridinannus* mentioned by Wygodzinsky (1951) are the relatively large size, prominent eyes, and a relatively well-developed ovipositor. The two known specimens were collected from a mid-elevation site in the province of Cartago and are deposited as slide mounts in the American Museum of Natural History (AMNH). Unfortunately, the collecting method was not recorded on the labels and the paratype is in poor condition. Other than some brief comments on the morphology of this taxon by Emsley (1969), who had not examined specimens of *Peloridinannus* himself, the genus has not been referred to in the literature since its description and no additional specimens have come to light.

As part of a US National Science Foundation "Advancing Revisionary Taxonomy and Systematics" (ARTS) program grant, the Heteropteran Systematics Lab at the University of California, Riverside has been focusing on biodiversity documentation of Schizopteridae and other Dipsocoromorpha. The project team to date has retrieved and sorted to morphospecies more than 18,000 specimens of Dipsocoromorpha from residue samples, over 6,000 of which have been identified as Schizopteridae, discovering unexpected genus-level diversity and overwhelming numbers of undescribed species. As an example, the genus *Chinannus* that contained two species from Costa Rica and Trinidad (Wygodzinsky 1948) is now documented across the Neotropical region and the number of described species is about to increase to 28 (A. Knyshov et al. unpublished). That taxonomic revision is based on about 400 specimens, which is a substantial amount of material for Schizopteridae that are typically collected in small numbers. During the present project, we examined a total of 59 *Peloridinannus* specimens, 52 of which were retrieved from residue samples housed at the FMNH. Relative to the sample size, the number of undescribed species discovered amongst these specimens is astonishing.

Here, we taxonomically revise the genus *Peloridinannus*, describe six new species, and for the first time document males of the genus. The taxonomy of Schizopteridae relies heavily on genus- and species-level characters derived from the male genitalia, and therefore the discovery of males for this genus is crucial. The known distribution for species of *Peloridinannus* now ranges from Central America to Southeastern Peru. *Peloridinannus* is currently not placed in any of the three subfamilies of Schizopteridae, in part resulting from the fact that the genus combines characters that Emsley (1969) treated as diagnostic for Hypselosomatinae, Schizopterinae and Ogeriinae. Clarifying the phylogenetic position of *Peloridinannus* is beyond the scope of this paper. Nevertheless, the digital images, scanning electron and confocal micrographs, and line drawings included provide the first thorough documentation of morphological characters for this striking genus and will be critical for future phylogenetic analyses of morphological characters across Schizopteridae.

2. Material and methods

2.1. Material

Three point-mounted specimens of *Peloridinannus* spp. and the slide-mounted *P. margaritatus* holotype and paratype were loaned from the AMNH and INBio. Two specimens were hand-collected by one of us (CW) during field work in Southeastern Peru. The majority of specimens (52) were discovered while sorting ethanol-preserved bulk samples of Dipsocoromorpha at the FMNH. As part of the ARTS Dipsocoromorpha project, other dry

(e.g., United States National Museum, Natural History Museum) or ethanol-preserved (e.g., Museum of Natural History Geneva, Florida State Collection of Arthropods) material was sorted, but no additional specimens of *Peloridinannus* were discovered.

2.2. Methods

Databasing. Specimens were associated with a matrix-code label with specimen identifier, consisting of a unique combination of prefix and eight-digit number, and databased using the PBI instance of the Arthropod Easy Capture database served from the AMNH https://research.amnh.org/pbi/locality/. Specimens for which geographic coordinates were absent from the label were georeferenced using Google Earth.

Maps. Coordinates for individual species were downloaded from the PBI database and imported into SimpleMappr http://www.simplemappr.net/.

Dissections. To study genitalic structures, the abdomen of selected male and female specimens was removed and immersed in warm ~10% KOH solution for variable periods of time to remove tissue. Female abdomina were stained using Chlorazol Black E to enhance visibility of the spermatheca, males remained unstained. Dissections were rinsed in deionized water and ethanol and temporarily mounted in glycerine on microscope slides.

Slide-mounting. Dissected specimens were permanently slide-mounted following protocols outlined in Noyes (1982) and Platner et al. (1999).

Digital habitus imaging (Figs. 1–3)**.** In preparation for habitus imaging, ethanol-preserved specimens were mounted in a watch glass on the surface of a small droplet of hand sanitizer and the watch glass then filled with 70% ethanol. Dry-mounted specimens were cleaned with a minuten pin before imaging. Dorsal, lateral, and ventral habitus images were taken using a Leica DFC 450 C Microsystems setup with Planapo 1.0 × and 2.0 × objectives and the Leica Application Suite (LAS) V4.3. Zerene Stacker was used to assemble composite images. Specimens AMNH_IZC 00150717 and AMNH_IZC 00150715 were imaged at the AMNH using a Leica MZ 16 and LAS V 2.5.0. Images were edited in Photoshop CS4 and image plates assembled in Corel Draw X3.

Scanning electron microscopy (Figs. 4, 5)**.** One male of *P. sinefenestra* sp.n. was dissected, mounted on a stub with an adhesive carbon sticker, coated with gold-palladium using a Cressington 108 auto sputter coater, and examined and documented using a Hitachi S-4700 electron microscope at the Central Facility for Advanced Microscopy and Microanalysis at the University of California, Riverside (UCR).

Imaging of slide (Figs. 6–8)**.** Temporary and permanently slide-mounted specimens were imaged using a GT Vision imaging system on a Zeiss Axioskop 2 compound microscope (UCR) or the Leica setup at the AMNH described above (*P. margaritatus* holotype and specimen of *P. stenomargaritatus* sp.n.)

Confocal imaging (Fig. 8)**.** One male of *P. moe* sp.n. was dissected and temporarily mounted on a microscopic slide in glycerine. The specimen was examined and imaged using a Leica SP5 Inverted confocal microscope with lasers of 488 nm and 543 nm and detectors set to diapasons of 500–535 nm and 555–700 nm.

Male genitalic illustrations (Fig. 9)**.** Overview illustrations of the male genitalia were prepared using a Nikon Eclipse 80i with camera lucida.

Species descriptions. Characters and character states, several of them cloned from other ongoing taxonomic projects on Schizopteridae, were created and a character matrix coded in mx (code and documentation available at http://mx.phenomix.org). The matrix was imported into WinClada ver. 1.00.08 (Nixon 2002) and species descriptions written to text files using the command "describe". Species descriptions were edited and the re-description of the genus assembled based on individual species descriptions.

Measurements. The total length was measured from images using the measure tool in LAS for one male and/or one female per species. Total length for macropterous and submacropterous specimens was measured from the apex of the head to the tip of the wing or tip of the abdomen, respectively.

Terminology. Morphological terminology follows a combination of sources, most importantly Wygodzinsky (1951), Emsley (1969) and Hill (2013, 2014). We built on Wygodzinsky (1951) in naming wing veins in *Peloridinannus*. Homologies of wing veins and cells are straightforward between different species of *Peloridinannus*, but are difficult to assess across other schizopterid taxa due to the high number of veins and cells in *Peloridinannus* spp. Where the introduction of terms in addition to those used by Wygodzinsky (1951) was necessary, we derived cell names from their anterior bordering veins (e.g., medial and cubital cells) or followed the terminology proposed by other authors (e.g., Emsley 1969) to tentatively propose homology with other schizopterids (e.g., basal, discal, and trapezoidal cells). The "areoles" described by Wygodzinsky (1951) as a diagnostic feature for *Peloridinannus* are round transparent areas on the wing comprised of weakly sclerotized cuticle compared to the surrounding areas. We follow A. Knyshov et al. (unpublished results) in referring to a protruding structure that is fused with the structure from which it originates and lacks muscle attachments, and is thus immobile, as "process"; this is in contrast to an "appendage" that has associated muscles and can therefore be moved against the structure from which it originates. External female genitalic structures (i.e. gonapophyses VIII and IX and styloids) are reduced in most schizopterids. However, some of these sclerites that form the ovipositor are present in Hypselosomatinae (e.g., Emsley 1969; Hill 2013), *Guapinannus* and *Peloridinannus* (Wygodzinsky 1951). Given that these sclerites look quite different in these taxa, homology assessment is difficult. We here refer to the lateral sclerites as gonapophyses VIII and the tongue-like sclerite that is embedded in the membrane between the gonapophyses as styloids.

3. Abbreviations

Morphological structures. 1An – first anal vein; **2An** – second anal vein; **aa** – aedeagal appendage; **bc** – basal cell; **C** – costa; **ca** – areoles within cells of hemelytron; **cc** – cubital cell; **cly** – clypeus; **co** – corium; **cp** – (hind) coxal pad; **cscm** – costal-subcostal margin; **Cu** – cubitus; **Cu1** – cubitus 1; **Cu2** – cubitus2; **dc1–2** – discal cells 1–2; **gaVIII** – gonapophysis VIII; **ipVIII/IX** – intersegmental process between segments VIII and IX; **l1–4** – labial segments 1–4; **lp** – left paramere; **M** – media; **mc** – medial cell; **md** – mandibular stylet; **mdl?** – apodeme likely representing mandibular lever; **me** – membrane (of hemelytron); **mx** – maxillary stylet; **oc** – ocellus; **pc** – pronotal collar; **pd** – pedicellus; **pe** – parempodia; **pre** – proepisternum; **procVII** – process on right side of segment VII; **py** – pygophore; **R** – radius; **r1–2** – radial cells 1–2; **rp** – right paramere; **sa** – scapus; **Sc** – subcosta; **sc1–3** – subcostal cells 1–3; **sp** – salivary pump; **spa** – spermatheca; **spd** – spermathecal duct; **spgl** – spermathecal gland; **spr** – spermathecal reservoir; **ssp** – suspensorium; **st** – styloid; **sty** – mandibular and maxillary stylets; **sX**; segment X; **t1–3** – tarsomeres 1–3; **tc** – trapezoidal cell; **v** – vesica; **vta** – vein-tracing areoles on hemelytron.

Natural history museums from which material has been loaned. AMNH – American Museum of Natural History, New York, USA; **INBio** – Instituto Nacional de Biodiversidad, San Jose, Costa Rica; **FMNH** – Field Museum of Natural History, Chicago, USA; **UCR** – Entomological Research Museum, University of California, Riverside, USA.

4. Taxonomy

4.1. *Peloridinannus* Wygodzinsky

Figs. 1–10

Type species: *Peloridinannus margaritatus* Wygodzinsky, 1951

Re-description. ***Male:*** total length 1.5–2.1 mm; macropterous or submacropterous, with both forms at least in some species occurring in the same species (Fig. 7); body shape broadly oval (e.g., Fig. 1, *P. laxicosta*), elongate ovoid (e.g., Fig. 1, *P. curly*), or elongate, almost parallel-sided (Fig. 3, *P. stenomargaritatus*). ***Coloration***: general coloration fairly uniformly pale brown with some lighter markings (Figs. 1, 2) or brown with some light and some dark markings (Fig. 3, *P. sinefenestra*); pronotum brown or pale brown with or without broad light band across posterior margin; hemelytron uniformly pale brown or brown with some dark brown patches and whitish lines. ***Vestiture***: consisting of dense cover of microtrichia on head except antennae, labium, clypeus and labrum, thorax except legs, on wings restricted to corium, and on abdomen; also with scattered semierect tuberculate setae on various body parts, legs in addition with some very long setae (Figs. 4, 5). ***Structure***: head in frontal view triangular or heart-shaped, vertex only slightly or strongly excavated; eyes about 2/3 as wide as synthlipsis (Fig. 6), ocelli present, adjacent to eyes (Fig. 6); labium reaching to about base of mesocoxa, 4-segmented (Fig. 6A,B), segments 2–3 relatively short, segment 4 long and tapering; internal head structures as in Fig. 6. Thorax with pronotal collar present (Fig. 4); scutellar apex, in dorsal view, short and triangular with pointed tip or rounded with blunt tip (Figs. 1–3), salient in lateral view; metathoracic scent gland evaporatoria not visible; metasternal spine represented by short process with short lateral prongs beset with microtrichia (Fig. 5D); tarsal formula 2-2-3 (Fig. 5A,C), parempodia setiform, dorsal arolia absent from all pairs of legs (Fig. 5); coxal pads small (Fig. 5D). Hemelytron (Fig. 7): with corium and membrane distinct (Fig. 7G); costal-subcostal margin narrow (Fig. 7D) or broad (Fig. 7B); subcostal cell subdivided into 2 (Fig. 7E,F), 3 (Fig. 7A–D,G) or 4 (Fig. 7H) (sub)cells, if with 2 cells, then cells 1 and 2 fused, with subcostal cell 3 shallow triangular or trapezoidal (Fig. 7A–D,G,H) or elongate ovoid (Fig. 7E,F); basal cell very small (Fig. 7A–D,G,H) or large (Fig. 7E,F); radial, discal, and trapezoidal cells short (Fig. 7E,F) or elongate (Fig. 7A–D,G,H); radial and discal cells divided (Fig. 7A,B) or undivided (Fig. 7C,D), feature can be asymmetrical on right and left hemelytron (Fig. 7E,F); medial and cubital cells of similar size (Fig. 7A) or with medial cell smaller than cubital cell (Fig. 7E); vein-tracing areoles and areoles within cells present (Fig. 7A,C,G) or absent (Fig. 7E), if present, vein-tracing areoles small (Fig. 7A) or large (Fig. 7G); wing-to-wing coupling structure with both anterior and posterior processes (Fig. 5E, inset); hindwing without jugal lobe; pre-genital abdomen slightly asymmetrical, with or without asymmetrical segment VII process on right side (Figs. 8, 9), if present, process long and slender (Fig. 8K), short and round (Fig. 8L), or short and double-lobed (Fig. 8O); tergites of segments VII, VIII, and IX sclerotized to various degrees and more (Fig. 9, *P. larry*) or less (Fig. 9, *P. laxicosta* or *P. curly*) symmetrical; spiracles laterally on sternum of segment VI and VII and tergum of segment VIII. Genitalia (Fig. 9): with intersegmental VIII/IX process long and straight (*P. curly*), of median length and slightly s-shaped (*P. margaritatus*), or flattened (Fig. 5G); aedeagal appendage present (*P. margaritatus*) or absent; vesica with less than one coil (e.g., *P. larry*), with one coil with apex protruding (Fig. 9, *P. curly*), or with one large coil and two more tightly curled apical coils (*P. sinefenestra*), vesical tip with (*P. margaritatus*) or without one or multiple subapical bends, tapering (e.g., *P. curly*), blunt (*P. margaritatus*), or very slightly inflated (*P. larry*); right paramere open c-shaped (*P. curly*), s-shaped (e.g., *P. larry*), sickle shaped with broad or narrow body (e.g., *P. laxicosta*), or curved and forked (*P. sinefenestra*); left paramere slender and uniformly curved, with round tip (e.g., *P. margaritatus*), sickle-shaped with acute tip (e.g., *P. moe*), sickle-shaped with basal process and rounded tip (*P. curly*), or s-shaped with tapering tip (*P. sinefenestra*). — ***Female:*** as male, with ovipositor consisting of gonapophyses VIII and well-developed styloids (Fig. 8); gonapophyses VIII of similar width throughout, with 4 strong lateral setae, and long, membranous apical process; styloids forming tongue-like, elongate ovoid structure, medially with fringe of microtrichia; reservoir of

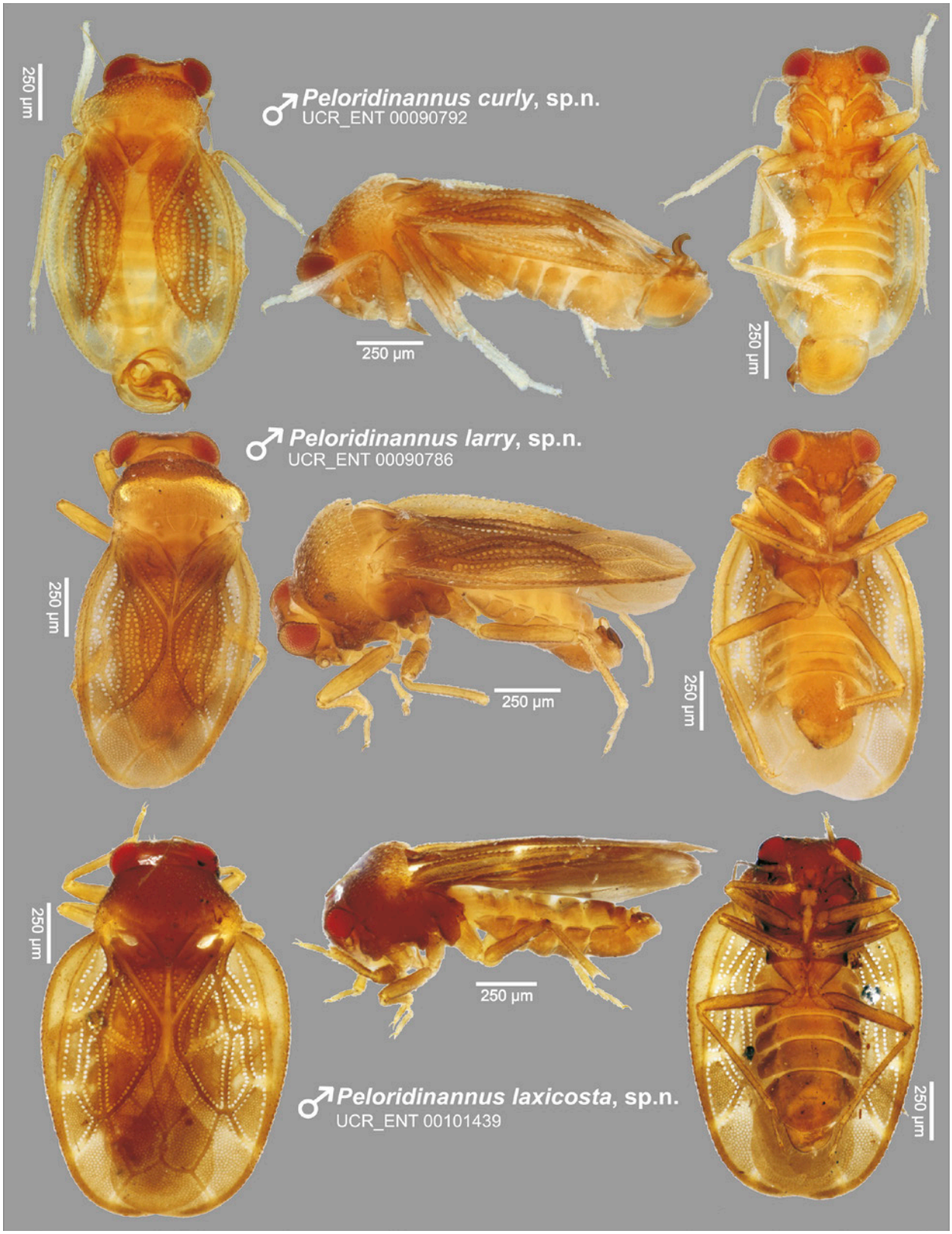

Fig. 1. Habitus of males of *Peloridinannus curly* sp.n., *P. larry* sp.n., and *P. laxicosta* sp.n. Orientation: dorsal (left), lateral (middle), and ventral (right) views.

spermatheca straight and inflated throughout (Fig. 8B) or with almost 180° bend (Fig. 8I) or L-shaped (~90° angle; Fig. 8E) and with slender basal and inflated posterior portion.

Differential diagnosis. Recognized amongst other Schizopteridae by the fairly large body size (~1.5–2.1 mm), relatively large eyes in males and females (Figs. 1–3), 4-segmented labium (Fig. 6), the 2-2-3 tarsal formula in

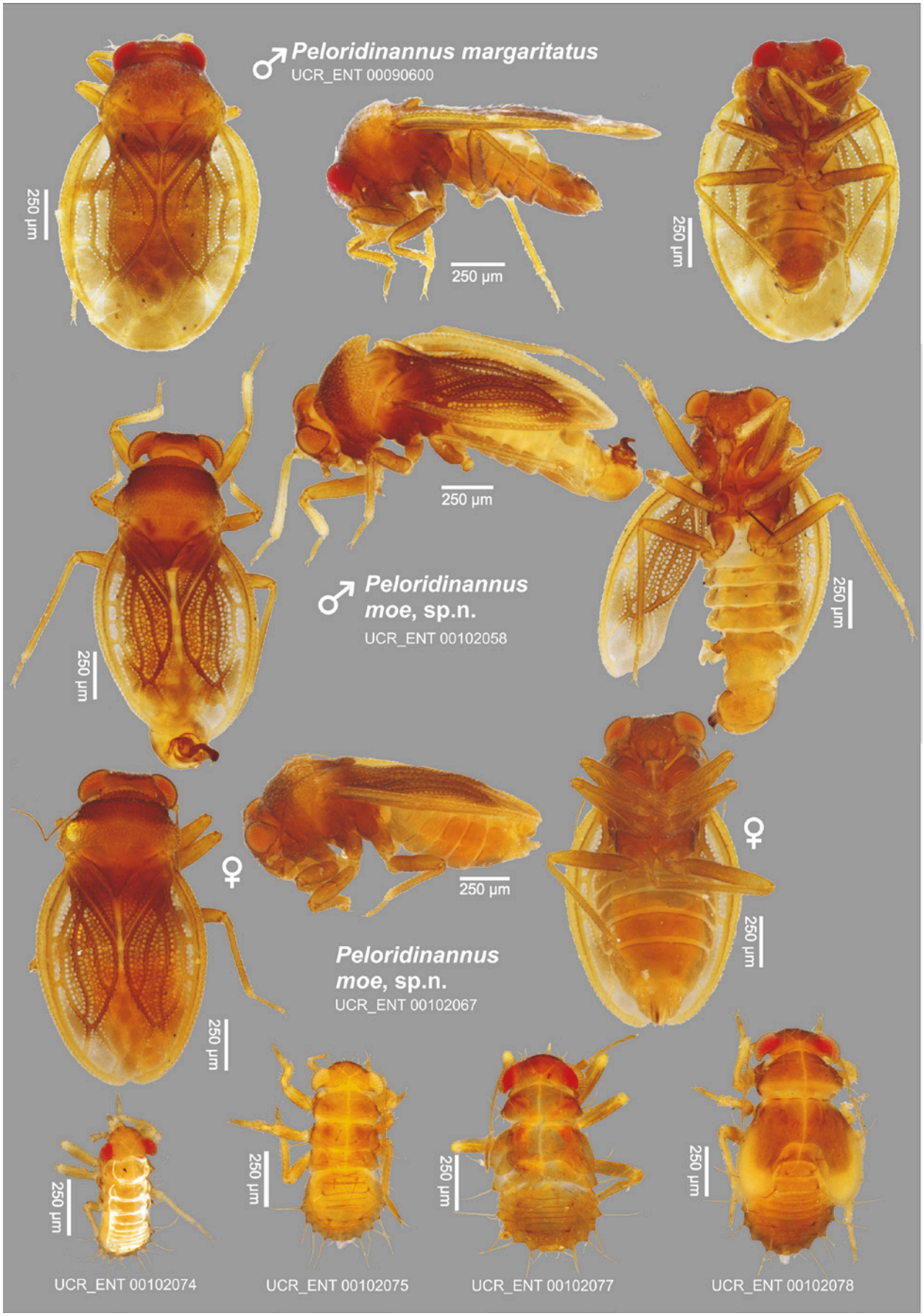

Fig. 2. Habitus of male of *Peloridinannus margaritatus* Wygodzinsky, 1951 and male, female, and immatures (bottom row) of *P. moe* sp.n.; immatures are (from left to right) second, third, fourth, and fifth instars, judging from size and development of wing pads. Orientation: adults in dorsal (left), lateral (middle), and ventral (right) views, immatures in dorsal view.

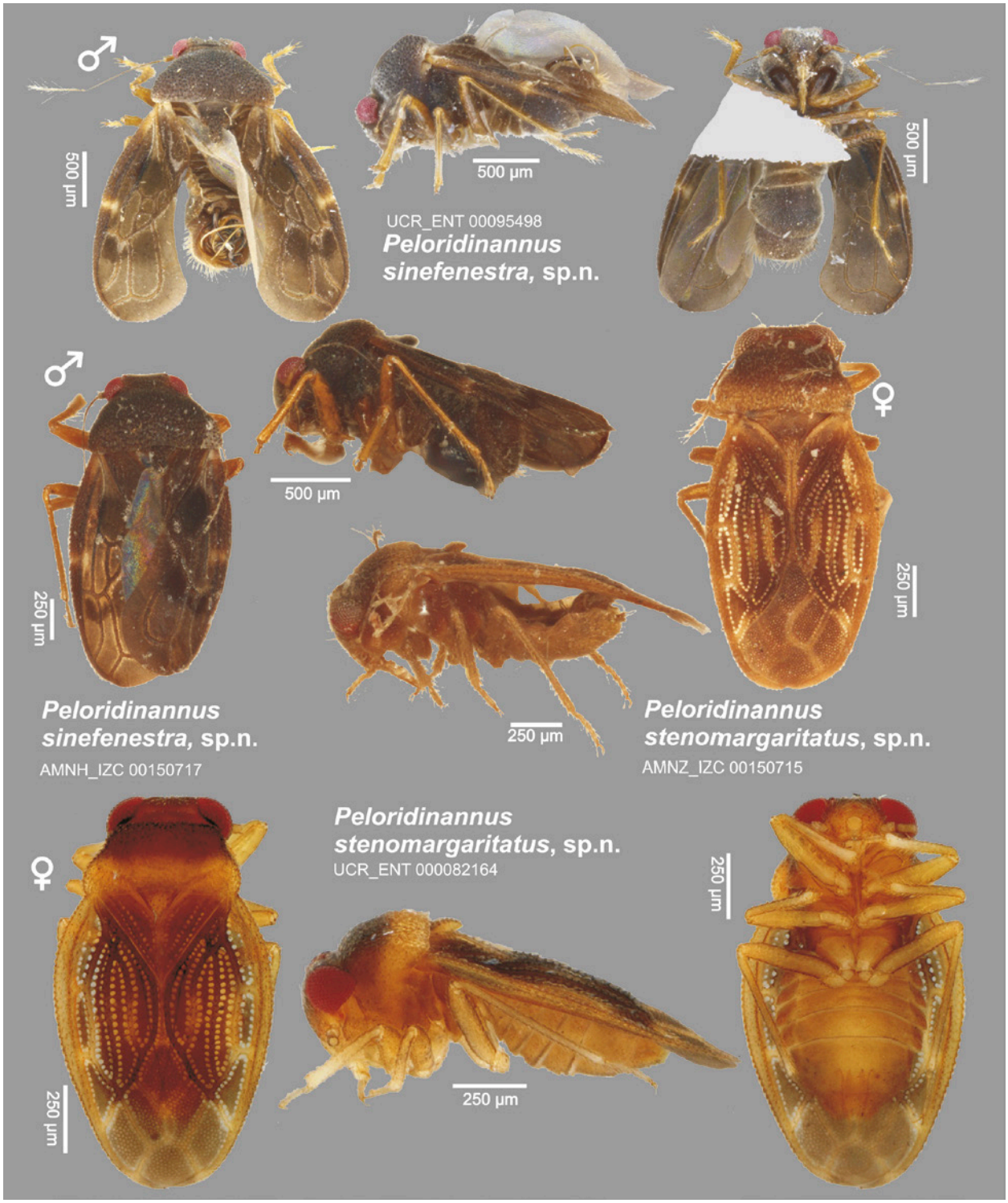

Fig. 3. Habitus of males of *Peloridinannus sinefenestra* sp.n. and females of *P. stenomargaritatus* sp.n. Orientation: dorsal (left), lateral (middle), and ventral (right) views top and bottom row, and dorsal and lateral views (middle row).

both males and females (Fig. 5), the hemelytron with distinctive wing-venation consisting of numerous cells and often with areoles tracing veins or within cells (Fig. 7), males in some species with large process on right side of segment VII (Figs. 8, 9) and always with intersegmental VIII/IX process (Fig. 9), vesica with less than one to multiple coils, right and left parameres of variable shapes (Fig. 9), and females with well-developed ovipositor (Fig. 8). The unique wing venation pattern clearly distinguishes this genus from all described Hypselosomatinae, Ogeriinae, and Schizopterinae. See discussion for additional comments.

Distribution. Species of *Peloridinannus* are documented from Central and South America.

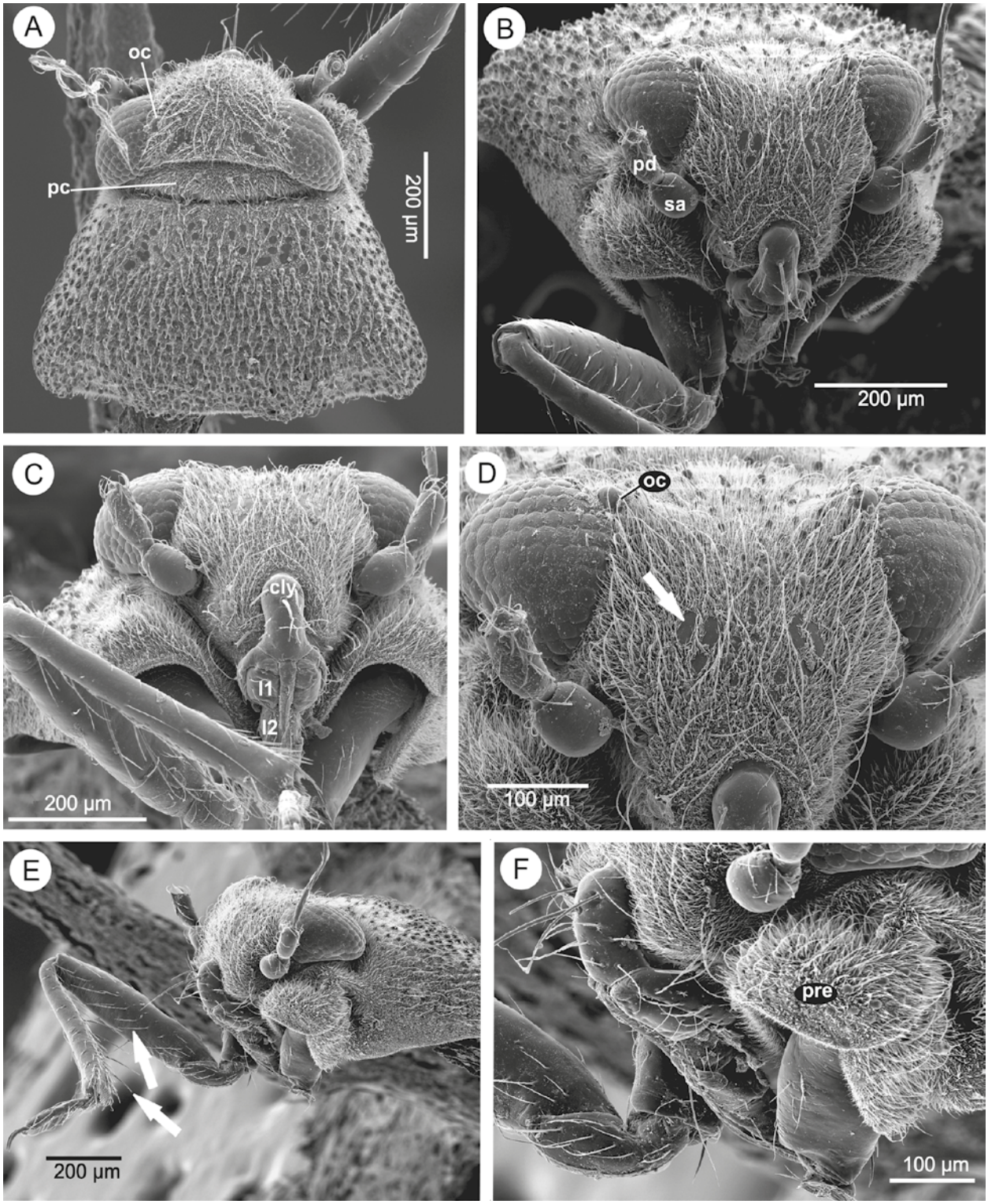

Fig. 4. Scanning electron micrographs of head and thoracic structures of the male of *Peloridinannus sinefenestra* sp.n. (UCR_ENT 00090782). **A**: Head and thorax, dorsal view. **B**: Head and thorax, frontal view. **C**: Head and thorax, frontal and slightly ventral view, showing labrum and basal labial segments. **D**: Close-up of frontal area of head, arrow indicating muscle scars. **E**: Head and thorax, lateral view, arrow indicating long setation on legs. **F**: Close-up of ventral portion of head and prothorax, showing inflated proepisternum.

Collecting method. Specimens were either hand-collected underneath bark or extracted using Berlese funnels. Berlese substrate comprised "epiphytic humus", "bark and sub-cortical debris", debris from "under bark of large stub", and the "center of decayed palm log".

Discussion. When describing *Peloridinannus* based on one macropterous and one submacropterous female specimen from Costa Rica, Wygodzinsky (1951) highlighted the unique wing features setting this genus apart from all other Schizopteridae described at that time. This

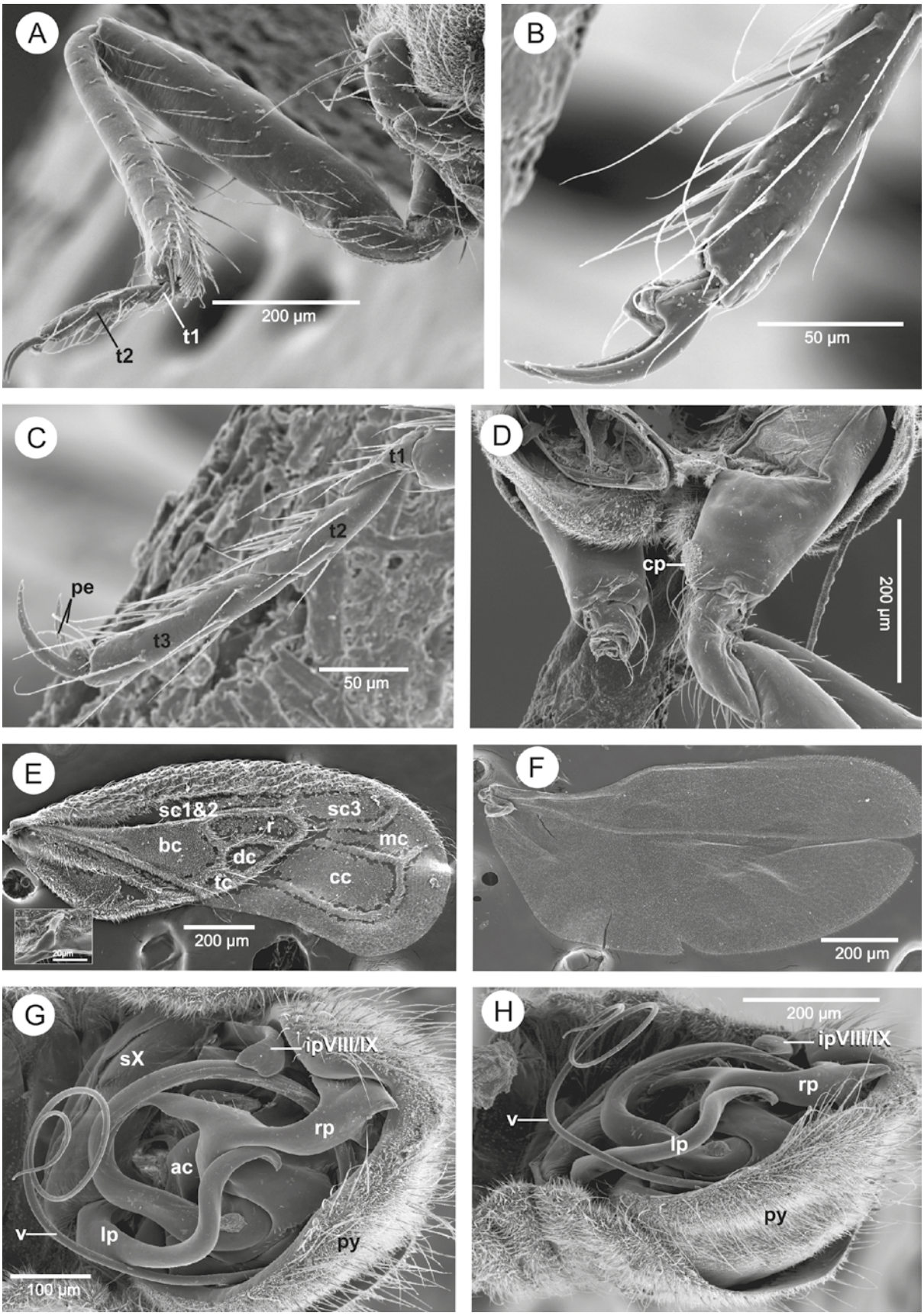

Fig. 5. Scanning electron micrographs of thoracic and abdominal structures of male of *Peloridinannus sinefenestra* sp.n. (UCR_ENT 00090782). **A**: Fore leg showing two-segmented tarsus, lateral view. **B**: Distal tarsomere and pretarsus of mid leg, showing lack of an arolium, lateral view. **C**: Three-segmented tarsus and pretarsus of hind leg, showing parempodia, lateral view. **D**: Right hind coxa with coxal pad (left hind coxa removed), caudal view. **E**: Hemelytron, dorsal view; inset showing wing-coupling structure, ventral view. **F**: Metathoracic wing, dorsal view. **G**: Pygophore and genitalic structures, dorsal view. **H**: Pygophore and genitalic structures, dorsolateral view.

statement still holds true in 2015 and after sorting more than 6,000 specimens of Schizopteridae as part of the Dipsocoromorpha ARTS project. Amongst Schizopteridae, *Peloridinannus* shares relatively rare features with the genus *Guapinannus* Wygodzinsky, 1951 another monotypic, female-based genus described from Costa Rica (Wygodzinsky 1951). Species in both genera have explanate hemelytra, a tarsal formula of 2-2-3 in both sexes (unpublished data for *Guapinannus*), and a well-developed ovipositor. However, both wing venation and structural details of the gonapophysis VIII and styloids differ distinctly between the two taxa. Emsley (1969) discussed relationships amongst and within schizopterid subfamilies and classified genera into subfamilies, but left *Peloridinannus* and *Guapinannus* unplaced. It is beyond the scope of this taxonomic revision to clarify the phylogenetic position of *Peloridinannus*. Nevertheless, several morphological features are worth highlighting in the context of current subfamily diagnoses. In *Peloridinannus*, the eyes are fairly large, the labium 4-segmented, the wing-to-wing coupling structure consists of both anterior and posterior processes, the male pre-genital abdomen is fairly symmetrical (except for the process on segment VII in some species), and gonapophyses VIII and styloids of the ovipositor are well-developed. Based on Emsley's (1969) outline, these characters are shared with some or all Hypselosomatinae. In addition to *Guapinannus*, the 2-2-3 tarsal formula in males is shared with several other genera, including *Pachyplagia* Gross, 1951, *Luachimonannus* Wygodzinsky, 1950, and *Kokeshia* Miyamoto, 1960, all classified by Emsley as Ogeriinae, but also *Humpatanannus* Wygodzinsky, 1950 and *Biturunannus* Wygodzinsky, 1948 amongst the Schizopterinae. Emsley (1969) diagnosed Schizopterinae by wing-venation characters, sexually dimorphic tarsal formula (males: 3-3-3; females: 2-2-3), males with dorsal arolium on fore and mid legs, hind wing without jugal lobe, and abdominal spiracles restricted to segments VI–VIII. Of these, *Peloridinannus* only shares the absence of the jugal lobe and number and position of spiracles.

In the three subfamilies of Schizopteridae sexual dimorphism with respect to wing type ranges from very limited to extreme, sometimes even within a genus as, e.g., in *Rectilamina* Hill, 1984 (Hill 1984) or *Schizoptera* Fieber, 1860 (Emsley 1969). Judging from the two species for which males and females are now documented, *P. margaritatus* and *P. moe*, sexual dimorphism in *Peloridinannus* may be limited: males and females are very similar in overall body shape, but also in wing type (macropterous or submacropterous).

Peloridinannus was not included in the molecular analysis of Dipsocoromorpha published by Weirauch & Štys (2014) and we have so far failed to obtain sequence data due to the age and suboptimal preservation of specimens in hand. Despite moderate to high branch support values for the monophyly of the three currently recognized subfamilies as well as a clade comprising Ogeriinae and Schizopterinae in that data set, unpublished data based on more comprehensive taxon sampling cast doubt on the monophyly of Ogeriinae and Schizopterinae. *Peloridinannus* (and *Guapinannus*) will almost certainly be crucial for tracing the early evolution of Ogeriinae + Schizopterinae, and should be coded in future combined morphological and molecular analyses.

4.2. Key to the species of *Peloridinannus*

1 Hemelytron with basal cell large, taking up the entire central portion of the corium (Fig. 7E,F), corium uniformly sclerotized, without areoles (Fig. 5E) ..... ***Peloridinannus sinefenestra* sp.n.**

1' Hemelytron with basal cell very small, restricted to the base of the wing and adjacent to the claval suture (Fig. 7A–D,G,H), corium and membrane (in part) with pattern of areoles (Fig. 7A–D,G,H) **2**

2 Hemelytron with radial, discal, and trapezoidal cells narrow and elongate, without cross-veins further subdividing radial and discal cells (Fig. 7C,D,G,H) **3**

2' Hemelytron with both, radial and discal cells subdivided by cross-veins (Fig. 7A,B) **6**

3 Hemelytron with large vein-tracing areoles, but without areoles within cells (Fig. 7G,H) [male unknown] ..... ***Peloridinannus stenomargaritatus* sp.n.**

3' Hemelytron with large vein-tracing areoles and with smaller areoles within cells (Fig. 7C,D); male with process on segment VII (Fig. 8K–O) **4**

4 Male with segment VII process elongate and narrow (Fig. 8K); submacropterous (Fig. 1) ..... ***Peloridinannus curly* sp.n.**

4' Male with short segment VII process rounded and broad (Fig. 8L–O); macropterous or submacropterous (Figs. 1, 2) **5**

5 Male with segment VII process double-lobed (Fig. 8O); submacropterous or macropterous males and females (Fig. 2) ..... ***Peloridinannus moe* sp.n.**

5' Male with segment VII process rounded, not bilobed (Fig. 8L); only macropterous males known (Fig. 1) . ..... ***Peloridinannus larry* sp.n.**

6 Costal margin of similar width along proximal half of hemelytron (Fig. 2) ..... ***Peloridinannus margaritatus* Wygodzinsky**

6' Costal margin narrow at base and abruptly widened, resulting in distinctly explanate condition (Fig. 1) ..... ***Peloridinannus laxicosta* sp.n.**

4.3. *Peloridinannus curly* sp.n.

Figs. 1, 8–10

Material. Holotype: PANAMA: Bocas del Toro: Almirante, trail to dam on Nigua Creek, 9.3003°N 82.40214°W, 23.iii.1959, Henry S. Dybas, ♂ (UCR_ENT 00090792) (FMNH).

Description. ***Male:*** total length ~1.53 mm; only one submacropterous specimen known; body shape elongate ovoid (Fig. 1). ***Coloration***: general coloration fairly uniformly pale brown with some lighter markings (Fig. 1),

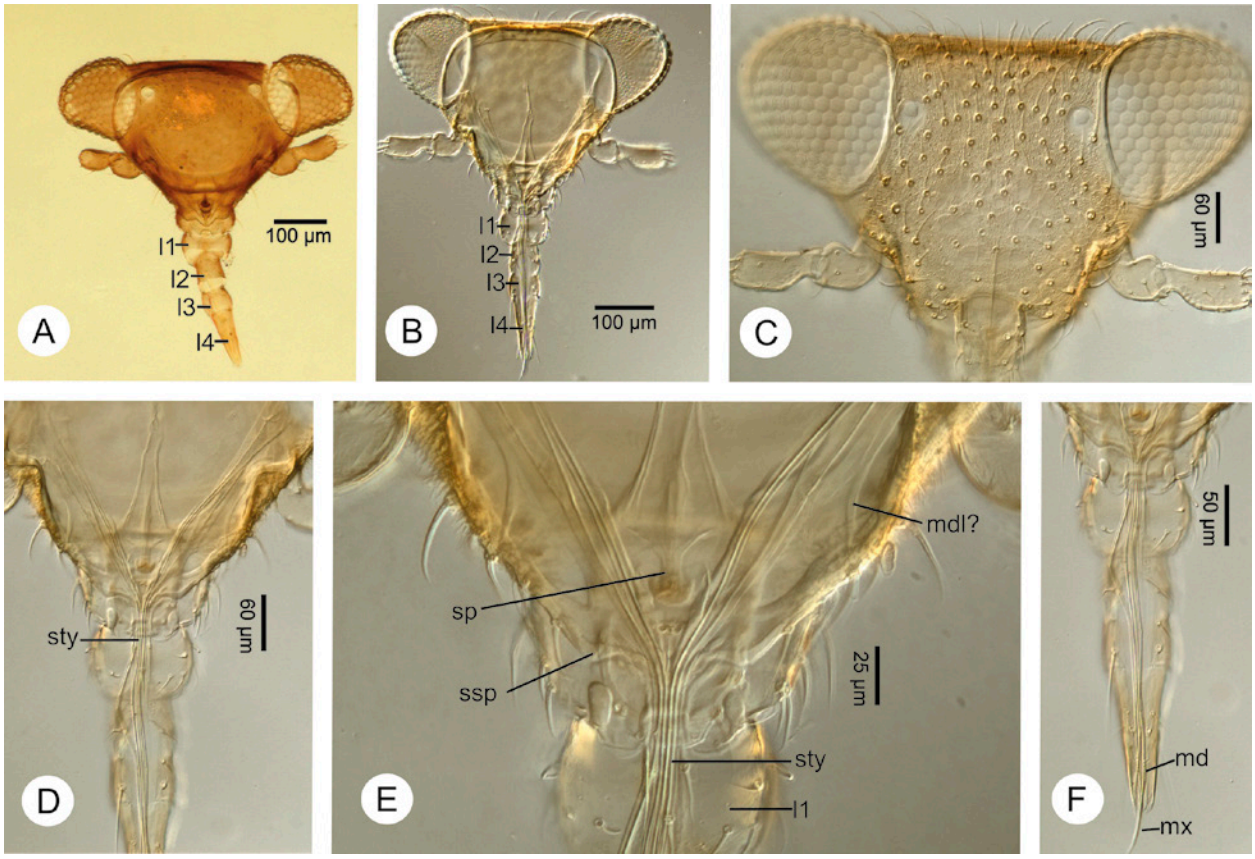

Fig. 6. Head structures of females of *Peloridinannus margaritatus* Wygodzinsky, 1951 (A, AMNH_IZC 00150355) and *P. stenomargaritatus* sp.n. (B–F, UCR_ENT 00082164). **A**–**C**: Head, frontal view. **D**: Base of labium, showing stylet bundle. **E**: Anterior portion of head and base of labium, showing salivary pump (sp) suspensorium (ssp), frontal view. **F**: Labium, showing individual mandibular and maxillary stylets in distal part, frontal view.

pronotum brown or pale brown with broad light band across posterior margin, hemelytron uniformly pale brown. ***Vestiture***: as in generic description. ***Structure***: head in frontal view heart-shaped, vertex strongly excavated; scutellum triangular and pointed; other head and thoracic features as in generic description. Hemelytron (Fig. 1): as in generic description, with costal-subcostal margin narrow; subcostal cells subdivided into 3 cells, with subcostal cell 3 shallow triangular or trapezoidal; basal cell very small; radial, discal, and trapezoidal cells elongate; radial and discal cells undivided; medial and cubital cells of similar size; vein-tracing areoles and areoles within cells present, with vein-tracing areoles large; abdomen with segment VII process on right side long and slender (Fig. 8K). Genitalia (Fig. 9): with intersegmental VIII/IX process long and straight; aedeagal appendage not distinct; vesica consisting of one coil with apex protruding, tip straight, tapering, and acute; right paramere open C-shaped; left paramere sickle-shaped with basal process and rounded tip. — ***Female:*** unknown.

Differential diagnosis. Distinguished amongst species of *Peloridinannus* by the hemelytron with basal cell very small, the radial, discal, and trapezoidal cells elongate, the radial and discal cells undivided, with both vein-tracing areoles and areoles within cells (Fig. 1), the segment VII process long and slender (Fig. 8K), the right paramere c-shaped and the left paramere sickle-shaped with basal process and rounded tip (Fig. 9). Most closely resembling *P. larry* sp.n., and *P. moe* sp.n. in habitus and wing venation and structure, but clearly distinguished by male genitalic features.

Etymology. Named after Jerome (Curly) Howard, one of the "Three Stooges", for the comical appearance of this species. Noun in apposition.

Collecting method. Unknown for the only known specimen.

Discussion. The single known male specimen was collected on the same date and at the same locality, however likely not in the same microhabitat, as the three known specimens of *P. larry* sp.n. described below. Specimens of *P. larry* sp.n., were extracted from a decayed palm log, but no collecting method was reported for *P. curly* sp.n. We argue that genitalic structures clearly separate these two species. The segment VII process in *P. moe* sp.n., the species for which we have the largest series (11 specimens) of male specimens shows no intraspecific

variation in shape, and we take this as evidence that the strikingly different shapes of the segment VII process in *P. curly* sp.n., *P. larry* sp.n., and *P. moe* sp.n. are species-diagnostic. The male holotype of *P. curly* sp.n., is macropterous, while the three specimens of *P. larry* sp.n. are submacropterous (Fig. 1). However, we refrain from placing too much emphasis on this potential species-diagnostic character, given that both macropterous and submacropterous males coexists in *P. moe* sp.n.

4.4. *Peloridinannus larry* sp.n.

Figs. 1, 8–10

Material. Holotype: PANAMA: Bocas del Toro: Almirante, trail to dam on Nigua Creek, 9.3003°N 82.40214°W, 5 m, 23 Mar 1959, Henry S. Dybas, ♂ (UCR_ENT 00090786) (FMNH). — Paratypes: PANAMA: Bocas del Toro: Almirante, trail to dam on Nigua Creek, 9.3003°N 82.40214°W, 5 m, 23 Mar 1959, Henry S. Dybas, 1♂ (UCR_ENT 00090785) (FMNH), 1♂ (UCR_ENT 00090787) (UCR).

Description. ***Male:*** total length ~1.55 mm; only macropterous specimens known; body shape elongate ovoid (Fig. 1). ***Coloration***: general coloration fairly uniformly pale brown with some lighter markings (Fig. 1), pronotum brown or pale brown with broad light band across posterior margin, hemelytron uniformly pale brown. ***Vestiture***: as in generic description. ***Structure***: head in frontal view heart-shaped, vertex strongly excavated; scutellum triangular and pointed; other head and thoracic features as in generic description. Hemelytron (Fig. 1): as in generic description, with costal-subcostal margin narrow; subcostal cells subdivided into 3 cells, with subcostal cell 3 shallow triangular or trapezoidal; basal cell very small; radial, discal, and trapezoidal cells elongate; radial and discal cells undivided; medial and cubital cells of similar size; vein-tracing areoles and areoles within cells present, with vein-tracing areoles large; abdomen with asymmetrical segment VII process on right side small and round (Fig. 8L). Genitalia (Fig. 9): with intersegmental VIII/IX process long and slightly curved; aedeagal appendage not distinct; vesica with less than one coil, tip with one subapical bend, tip very slightly inflated; right paramere s-shaped; left paramere slender, uniformly curved, with round tip. — ***Female:*** unknown.

Differential diagnosis. Distinguished amongst species of *Peloridinannus* by the hemelytron with basal cell very small, the radial, discal, and trapezoidal cells elongate, the radial and discal cells undivided, with both vein-tracing areoles and areoles within cells (Fig. 1), the segment VII process small and round (Fig. 8L), the right paramere s-shaped, and the left paramere slender, uniformly curved, with round tip (Fig. 9). Most closely resembling *P. curly* sp.n., and *P. moe* sp.n. in habitus and wing venation and structure, but clearly distinguished by male genitalic features.

Collecting method. The three known male specimens were collected during the same collection event using Berlese extraction of the "centre of a decayed palm log".

Etymology. Named after Larry Fine, one of the "Three Stooges", for the comical appearance of this species. Noun in apposition.

Discussion. See discussion of *P. curly* sp.n. above.

4.5. *Peloridinannus laxicosta* sp.n.

Figs. 1, 7, 9, 10

Material. Holotype: PERU: Cusco: Consuelo, Manu Road km 165, 13.22387°S 72.01464°W, 01 Oct 1982, L.E. Watrous, G. Mazurek, ♂ (UCR_ENT 00101439) (FMNH). — Paratypes: PERU: Cusco: Consuelo, Manu Road km 165, 13.22387°S 72.01464°W, 01 Oct 1982, L.E. Watrous, G. Mazurek, 2♂ (UCR_ENT 00102054, UCR_ENT 00102055) (FMNH), 1♂ (UCR_ENT 00101450) (UCR). Note: georeferenced to Cusco province, given the elevation gradient in that area, we do not provide an elevation for this locality.

Description. ***Male:*** total length ~1.59 mm; only macropterous specimens known; body shape broadly oval (Fig. 1). ***Coloration***: general coloration fairly uniformly pale brown with some lighter markings (Fig. 1), pronotum brown or pale brown with broad light band across posterior margin, hemelytron pale brown or brown with light markings along some veins and crossveins. ***Vestiture***: as in generic description. ***Structure***: head in frontal view triangular, vertex only slightly excavate; scutellum triangular and pointed; other head and thoracic features as in generic description. Hemelytron (Fig. 1): as in generic description, with costal-subcostal margin broad; subcostal cells subdivided into 3 cells, with subcostal cell 3 triangular or trapezoidal; basal cell very small; radial, discal, and trapezoidal cells elongate; radial and discal cells both divided by cross-veins; medial and cubital cells of similar size; vein-tracing areoles and areoles within cells present, with vein-tracing areoles small; abdomen with asymmetrical segment VII process absent (Fig. 9). Genitalia (Fig. 9): with intersegmental VIII/IX process of median length, slightly s-shaped; aedeagal appendage present, short and slender; vesica with less than one coil, tip subapically with multiple bends, tip slightly blunted; right paramere sickle-shaped with broad blade; left paramere slender, uniformly curved, with round tip. — ***Female:*** unknown.

Differential diagnosis. Distinguished amongst species of *Peloridinannus* by the broad oval body shape, the hemelytron with broad costal-subcostal margin that is abruptly widened basally, the basal cell very small, the radial, discal, and trapezoidal cells elongate, the radial and discal cells both divided by cross-veins, the vein-tracing areoles and areoles within cells present, with vein-tracing areoles small (Fig. 1), the absence of the segment VII process,

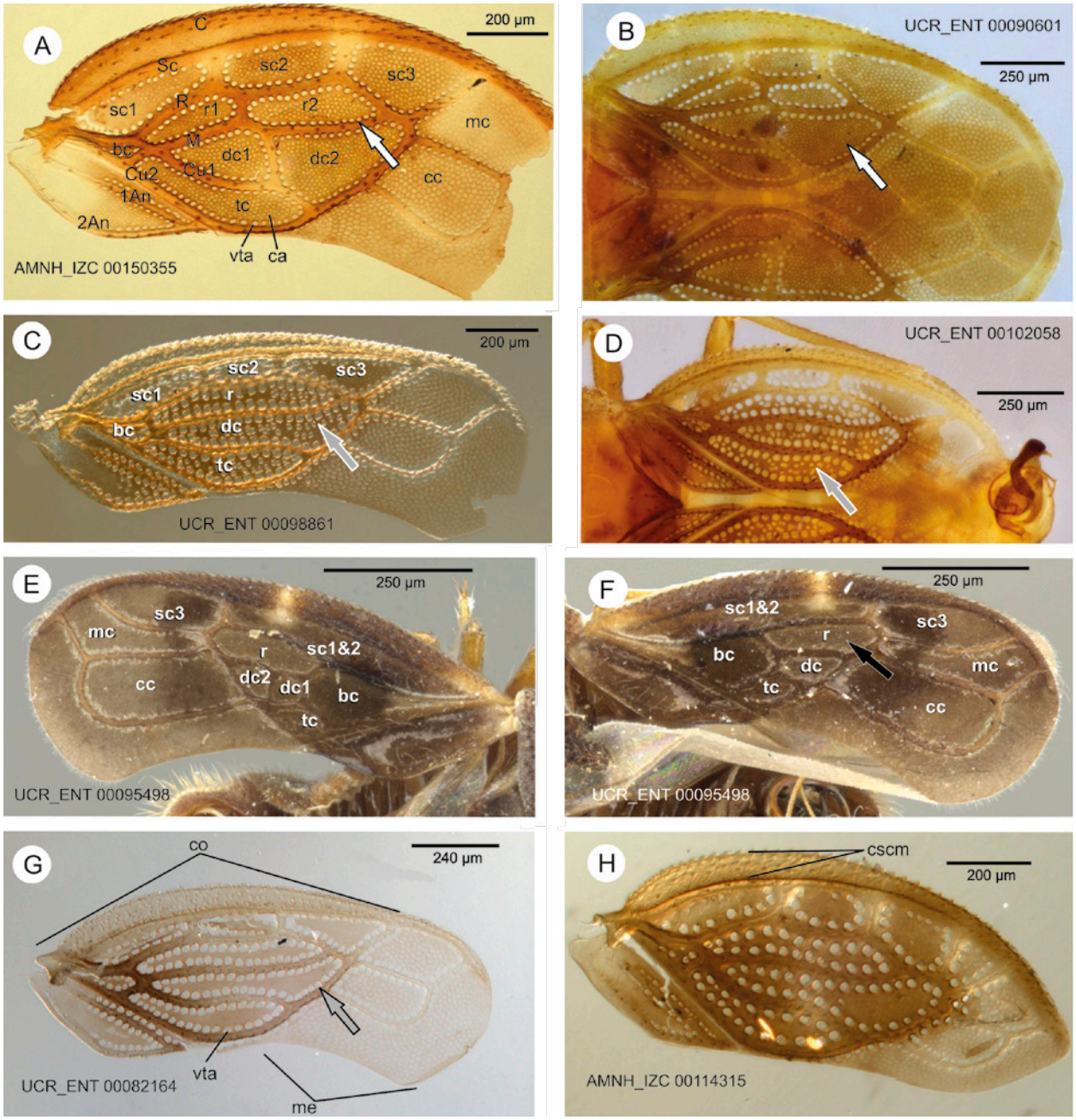

Fig. 7. Hemelytra of *Peloridinannus* spp. (all dorsal view) showing wing types (macropterous, submacropterous), venation patterns, areole size and distribution, and vein asymmetry. **A**: *P. margaritatus*, female holotype. **B**: *P. margaritatus*, male. **C**: *P. moe* sp.n., macropterous male. **D**: *P. moe* sp.n., submacropterous male. **E**,**F**: Left and right wing of *P. sinefenestra* sp.n., male, showing asymmetrical dc subdivision. **G**: *P. stenomargaritatus* sp.n., macropterous female. **H**: *P. stenomargaritatus*, submacropterous female. – Arrows: white: small areoles along veins; grey: large areoles along veins; black: areoles absent.

male genitalia with a small aedeagal appendage, vesica with subapical bends, and the sickle-shaped right paramere (Fig. 9). Most closely resembling *P. margaritatus* in habitus and structure and venation of hemelytron, but distinguished by the more abruptly widened costal-subcostal margin and the broader blade of the right paramere (Fig. 9).

Etymology. Derived from Latin "laxus" (masculine genitive: laxi) meaning "wide" and a reference to the wide costal margin of the hemelytron. Noun in apposition.

Collecting method. The four known specimens were collected sifting leaf litter from "under crown of felled tree".

Discussion. This species closely resembles *P. margaritatus*, with which it shares the pattern of wing venation and areole distribution and size. Male pre-genitalic abdomen and genitalia of the two species are very similar in the absence of the segment VII process, the shape of the intersegmental process VIII/IX, the simple and curved left paramere, the sickle-shaped right paramere, and the short and slender vesica that features several subapical bends.

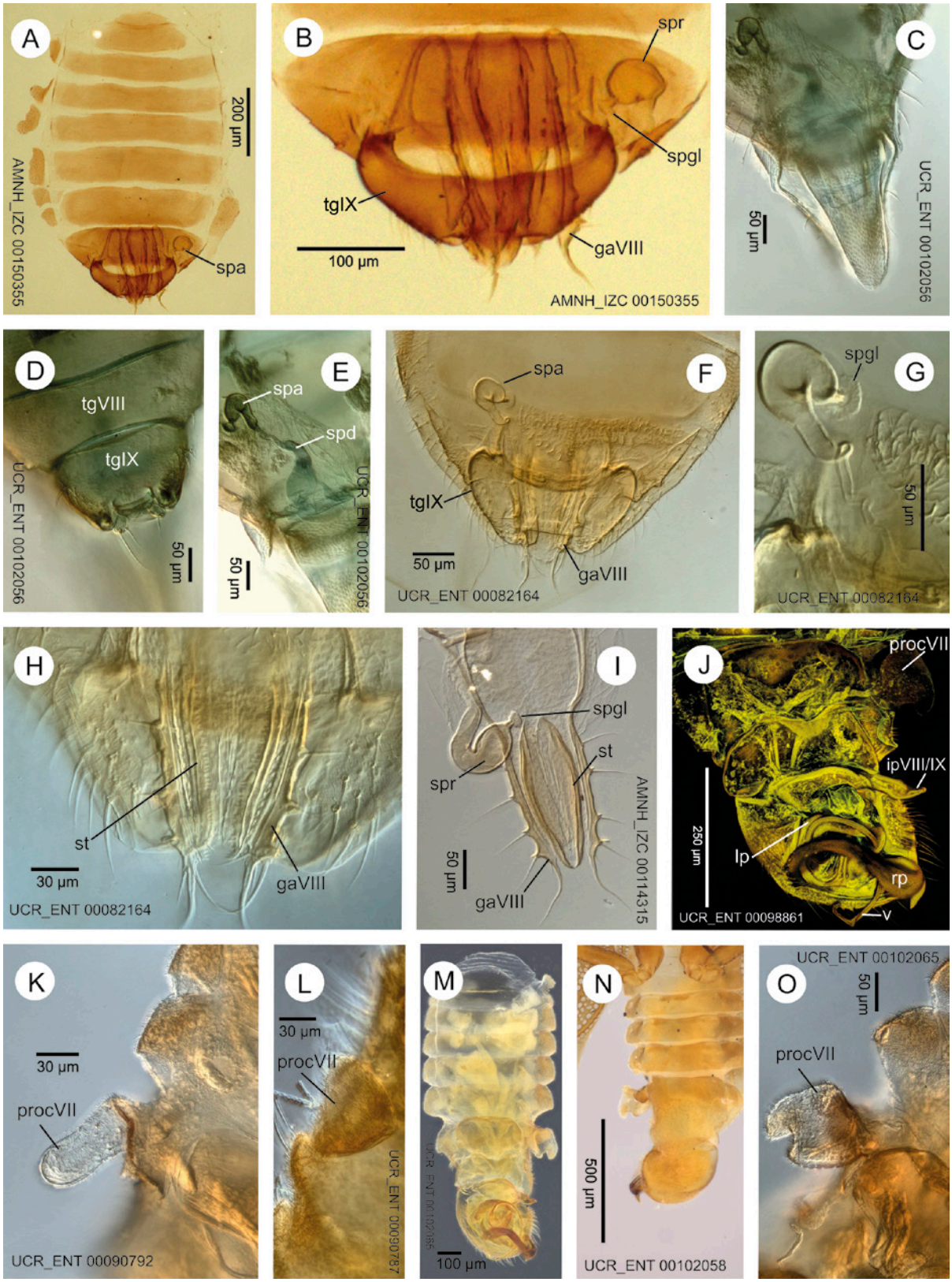

Fig. 8. Female and male genitalic and pre-genitalic abdominal structures in *Peloridinannus* spp. (all dorsal view, except C, E, and N ventral view) showing ovipositor, spermatheca, and segment VII processes; A–I and K–O are light compound microscopic images, J is a confocal image. **A**,**B**: *P. margaritatus*, female holotype, overview (A) of abdomen and genitalic structures and close-up (B) of genitalic structures including ovipositor and spermatheca. **C**–**E**: *P. moe* sp.n., female, apex of abdomen in ventral (C) and dorsal (D) view with close-up of spermatheca (E). **F**–**I**: *P. stenomargaritatus* sp.n., females, apex of abdomen showing ovipositor and spermatheca (F), spermatheca (G), gonapophyses VIII and styloid (H), and dissected spermatheca and gonapophyses (I). **J**: *P. moe* sp.n., male, genitalia and part of pre-genital abdomen. **K**,**L**,**O**: close-ups of processes of segments VII of males of *P. curly* sp.n. (K), *P. larry* sp.n. (L), and *P. moe* sp.n. (O). **M**,**N**: dorsal (M) and ventral (N) view of abdomen in male *P. moe* sp.n.

4.6. *Peloridinannus margaritatus* Wygodzinsky, 1951

Figs. 2, 6, 7–10

Material. Holotype: COSTA RICA: Cartago: Turrialba Co.: Chitaría, 9.9369°N 83.59093°W, 760 m, 29 Apr 1944 - 30 Apr 1944, Bierig, ♀ (AMNH_IZC 00150355) (AMNH). — Other Specimens Examined: COSTA RICA: Puntarenas: OTS Sta. finca Las Cruces, San Vito, 8.76666°N 82.96666°W, 1219 m, 19 Mar 1973, J. A. Wagner, J. B. Kethley, 2♂ (UCR_ENT 00090601, UCR_ENT 00090600) (FMNH).

Re-description. ***Male:*** total length ~1.58 mm; only macropterous specimens known; body shape oval (Fig. 2). ***Coloration***: general coloration fairly uniformly pale brown with some lighter markings (Fig. 2), pronotum brown or pale brown with broad light band across posterior margin, hemelytron pale brown or brown with light markings along some veins and crossveins. ***Vestiture***: as in generic description. ***Structure***: head in frontal view triangular, vertex only slightly excavate; scutellum triangular with pointed tip; other head and thoracic features as in generic description. Hemelytron (Fig. 7B): as in generic description, with costal-subcostal margin broad; subcostal cells subdivided into 3 cells, with subcostal cell 3 triangular or trapezoidal; basal cell very small; radial, discal, and trapezoidal cells elongate; radial and discal cells both divided by cross-veins; medial and cubital cells of similar size; vein-tracing areoles and areoles within cells present, with vein-tracing areoles small; abdomen with segment VII process absent (Fig. 9). Genitalia (Fig. 9): with intersegmental VIII/IX process of median length, slightly s-shaped; aedeagal appendage present, short and slender; vesica with less than one coil, tip subapically with multiple bends, tip slightly blunted; right paramere sickle-shaped with slender body; left paramere slender, uniformly curved, with round tip. — ***Female:*** as male, see also Figs. 6A and 7A, with tarsal formula of the single known female (the holotype) ?-2-3 (fore leg missing); ovipositor as in generic description, with reservoir of spermatheca inflated throughout and without bend (Fig. 8A,B).

Differential diagnosis. Distinguished amongst species of *Peloridinannus* by the oval body shape, the hemelytron with gradually broadened costal-subcostal margin, the basal cell very small, the radial, discal, and trapezoidal cells elongate, the radial and discal cells both divided by cross-veins, the vein-tracing areoles and areoles within cells present, with vein-tracing areoles small (Fig. 2), the absence of the segment VII process, male genitalia with a small aedeagal appendage, vesica with subapical bends, the sickle-shaped right paramere (Fig. 9), and the spermatheca inflated and without bend (Fig. 8B). Most closely resembling *P. laxicosta* sp.n., in habitus, structure and venation of hemelytron, but distinguished by the more gradually expanded costal-subcostal margin and the narrower blade of the right paramere (Fig. 9).

Collecting method. The label data for the two males indicate that these specimens were collected by sifting leaf litter, specifically "FLC Berlese epiphytic humus 2000 cc. conc., cleared dead fall".

Discussion. Given the identical wing venation pattern and areole distribution and size as well as color pattern, we are confident that the two male specimens from Costa Rica are conspecific with the female designated as the holotype of *P. margaritatus* by Wygodzinsky (1951). See discussion under *P. laxicosta* sp.n., for discussion of similarities and differences between these two species.

4.7. *Peloridinannus moe* sp.n.

Figs. 2, 7–10

Material. Holotype: PANAMA: Panama: Barro Colorado Co.: Barro Colorado Island, 9.15726°N 79.84668°W, 170 m, 21 Jan 1959, H.S. Dybas, ♂ (UCR_ENT 00102058) (FMNH). — Paratypes: PANAMA: Panama: Barro Colorado Co.: Barro Colorado Island, 9.15726°N 79.84668°W, 170 m, 21 Jan 1959, H.S. Dybas, 7♀ (UCR_ENT 00102057, UCR_ENT 00102066-UCR_ENT 00102071), 7♂ (UCR_ENT 00102059-UCR_ENT 00102065) (FMNH), 2♂ (UCR_ENT 00090770, UCR_ENT 00090771), 1♀ (UCR_ENT 00102056) (UCR); 22 Jan 1959, H.S. Dybas, 1♀ (UCR_ENT 00090736), 1♂ (UCR_ENT 00098861), 2♀ (UCR_ENT 00098831, UCR_ENT 00115659) (FMNH). — Other Specimens Examined: PANAMA: Panama: Barro Colorado Co.: Barro Colorado Island, 9.15726°N 79.84668°W, 170 m, 21 Jan 1959, H.S. Dybas, 15 juveniles (UCR_ENT 00102072-UCR_ENT 00102083, UCR_ENT 00098828-UCR_ENT 00098830) (FMNH); 22 Jan 1959, H.S. Dybas, 2 juveniles (UCR_ENT 00098832, UCR_ENT 00115660) (FMNH).

Description. ***Male:*** total length ~1.8 mm; macropterous and submacropterous; body shape elongate ovoid (Fig. 2). ***Coloration***: general coloration fairly uniformly pale brown with some lighter markings (Fig. 2), pronotum brown or pale brown with broad light band across posterior margin, hemelytron uniformly pale brown. ***Vestiture***: as in generic description. ***Structure***: head in frontal view heart-shaped, vertex strongly excavated; scutellum triangular and with pointed tip; other head and thoracic features as in generic description. Hemelytron (Figs. 2, 7D): as in generic description, with costal-subcostal margin narrow; subcostal cells subdivided into 3 cells, with subcostal cell 3 shallow triangular or trapezoidal; basal cell very small; radial, discal, and trapezoidal cells elongate; radial and discal cells undivided; medial and cubital cells of similar size; vein-tracing areoles and areoles within cells present, with vein-tracing areoles large; abdomen with asymmetrical segment VII process on right side double-lobed (Fig. 8M–O). Genitalia (Fig. 9): with intersegmental VIII/IX process long and slightly curved; aedeagal appendage not distinct; vesica with less than one coil, tip with one subapical bend, tip very slightly inflated; right paramere s-shaped; left paramere sickle-shaped with acute tip. — ***Female:*** ~1.52 mm; as in Fig. 2, tarsal formula and female genitalia (Fig. 8C–E) as in generic description, spermatheca with L-shaped re-

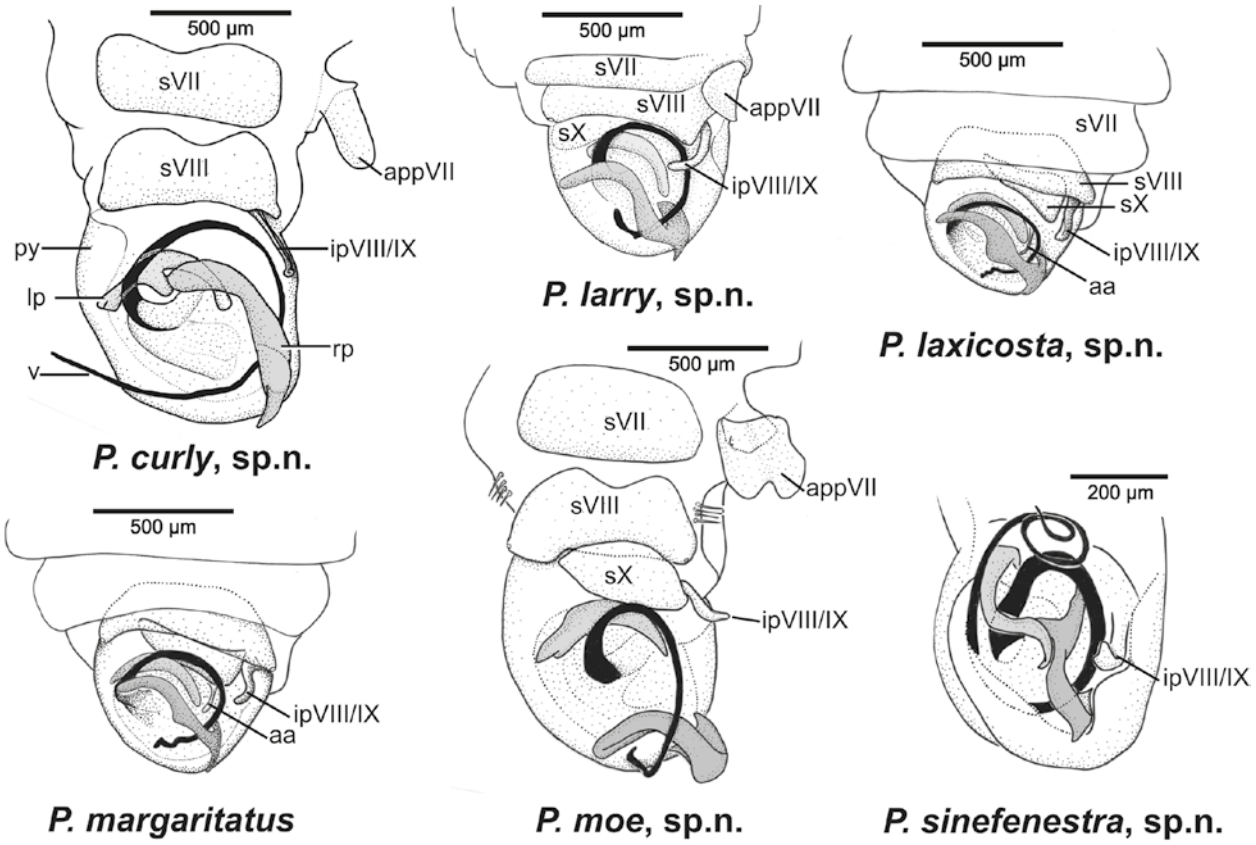

Fig. 9. Male genitalic features of *Peloridinannus* spp., dorsal view, showing species-diagnostic differences in vesica, right and left parameres, intersegmental process VIII/IX, and process of segment VII.

servoir, consisting of a slender basal and inflated distal portion (Fig. 8E). — ***Immatures:*** as in Fig. 2, with long and stout abdominal setae.

Differential diagnosis. Distinguished amongst species of *Peloridinannus* by the hemelytron with basal cell very small, the radial, discal, and trapezoidal cells elongate, the radial and discal cells undivided, with both vein-tracing areoles and areoles within cells (Figs. 2, 7C,D), the segment VII process double-lobed (Fig. 8M–O), the right paramere s-shaped, the left paramere sickle-shaped with acute tip (Fig. 9), and the spermatheca with L-shaped bend (Fig. 8E). Most closely resembles *P. curly* sp.n. and *P. larry* sp.n. in habitus and wing venation and structure, but clearly distinguished by male genitalic features.

Collecting method. Specimens were collected using Berlese extraction of substrate gathered from "underneath the bark of a large stub" and in "bark and sub-cortical debris".

Etymology. Named after Moe Howard, one of the "Three Stooges". Noun in apposition.

Discussion. See discussion under *P. curly* sp.n. for a comparison between these two species and *P. larry* sp.n. Both males and females can be macropterous and submacropterous in this species. Immatures were collected together with males and females, we assume that they are conspecific, and here document specimens that represent the second to fifth instars.

4.8. *Peloridinannus sinefenestra* sp.n.

Figs. 3–5, 7, 9, 10

Material. Holotype: COSTA RICA: Limon: Reserva Biologica Hitoy Cerere, Sendero Espavel, 9.63894°N 83.03881°W, 560 m, 14 Mar 2003 - 25 Mar 2003, E. Rojas, B. Gamboa, W. Arana, ♂ (UCR_ENT 00095498) (INBIO). — Paratype: ECUADOR: Cotopaxi: Tinalandia, Santo Domingo de los Colorados, 0.25415°S 79.17193°W, 700 m, 18 May 1993, J.J. Morrone, 1♂ (AMNH_IZC 00150717) (AMNH). — Other Specimens Examined: PANAMA: Bocas del Toro: Almirante, trail to dam on Nigua Creek, 9.3003°N 82.40214°W, 5 m, 23 Mar 1959, Henry S.Dybas, 1♂ (UCR_ENT 00090782) (FMNH).

Description. ***Male:*** total length ~2.1 mm; only macropterous specimens known; body shape elongate ovoid (Fig. 3). ***Coloration***: general coloration dark brown with some light and some dark markings (Fig. 3), pronotum uniformly brown or pale brown, hemelytron brown with some dark brown patches and whitish lines. ***Vestiture***: as in generic description. ***Structure*** (Figs. 4, 5): head in frontal view heart-shaped, vertex strongly excavated;

scutellum with spine rounded and with blunt tip; other head and thoracic features as in generic description. Hemelytron (Figs. 3, 7E,F): as in generic description, with costal-subcostal margin narrow; subcostal cells subdivided into 2 cells; subcostal cell 3 elongate oval; basal cell large; radial, discal, and trapezoidal cells short; radial and discal cells asymmetrical (divided and/or undivided); medial and cubital cells with medial cell smaller than cubital cell; vein-tracing areoles and areoles within cells absent; abdomen with segment VII process absent (Fig. 9). Genitalia (Figs. 5, 9): with intersegmental VIII/IX process flattened; aedeagal appendage not distinct; vesica consisting of at least one large coil and two more tightly curled apical coils, tip straight, tapering, and acute; right paramere curved and forked; left paramere s-shaped with tapering tip. — ***Female:*** unknown.

Differential diagnosis. Distinguished amongst species of *Peloridinannus* by the large size, dark brown coloration, hemelytron with basal cell large, the radial, discal, and trapezoidal cells short, without vein-tracing areoles and areoles within cells (Figs. 3, 7E,F), segment VII without process (Fig. 9), the vesica with at least one large and two more tightly curled apical coils (Fig. 9), the right paramere curved and forked, and the left paramere s-shaped with tapering tip. Unlike any other known *Peloridinannus* species in lacking areoles on the hemelytron and distinctive male genitalic features.

Collecting method. Specimen UCR_ENT 00095498 was collected using a yellow pan trap, AMNH_IZC 00150717 at light, and UCR_ENT 00090782 from the center of a decayed palm log.

Etymology. Derived from Latin "sine fenestra" meaning "without window", referring to the absence of areoles on the hemelytron.

Discussion. Three male specimens are known from distant localities in Costa Rica, Panama, and Ecuador. There are two noteworthy features: the wing venation of the specimen from Costa Rica is asymmetrical, with the discoidal cell of the left wing being subdivided into two cells (Figs. 3, 7E,F). The right wing is consistent with the pattern seen in the specimens from Panama and Ecuador. Secondly, the vesica appears to be longer in the Costa Rica (Fig. 3) specimen compared to the specimen from Panama (Figs. 5, 9). Given that the three specimens are very similar in general habitus, wing structure, venation, and all other details of male genitalic features, we here treat them as conspecific.

4.9. *Peloridinannus stenomargaritatus* sp.n.

Figs. 3, 6–10

Material. Holotype: PERU: Madre de Dios: Los Amigos Biol. Sta. trail 14, 12.57141°S 70.09538°W, 231 m, 22 Dec 2010, C. Weirauch, ♀ (UCR_ENT 00082164) (UCR). — Paratype: PERU: Madre de Dios: Los Amigos Biol.Sta. trail 14, 12.57141°S 70.09538°W, 231 m, 22 Dec 2010, C. Weirauch, 1♀ (UCR_ENT 00044295) (UCR). — Other Specimens Examined: COSTA RICA: Cartago: Turrialba Co.: Chitaría, 9.9369°N 83.59093°W, 760 m, 29 Apr 1944 - 30 Apr 1944, Bierig, (Unknown), 1♀ (AMNH_IZC 00114315) (AMNH). PERU: Junin: San Ramon de Pangoa, 40 km SE Satipo, 11.48333°S 74.4°W, 750 m, 24 Mar 1972, R.T. and J.C. Schuh, 1♀ (AMNH_IZC 00150715) (AMNH).

Description. ***Female:*** total length ~1.75 mm; macropterous (Fig. 3) and submacropterous (Fig. 7H); body shape elongate (Fig. 3). ***Coloration***: general coloration fairly uniformly pale brown with some lighter markings (Fig. 3), pronotum brown or pale brown with broad light band across posterior margin, hemelytron pale brown or brown with light markings along some veins and crossveins. ***Vestiture***: as in generic description. ***Structure*** (Fig. 6B–F): head in frontal view triangular, vertex only slightly excavate; scutellum triangular and with pointed tip; other head and thoracic characters as in generic description. Hemelytron (Fig. 7G,H): as in generic description, with costal-subcostal margin narrow; subcostal cells subdivided into 3 cells, with subcostal cell 3 shallow triangular or trapezoidal; basal cell very small; radial, discal, and trapezoidal cells elongate; radial and discal cells undivided; medial and cubital cells of similar size; vein-tracing areoles on hemelytron present, but areoles within cells absent. Genitalia (Fig. 8F–I): as in generic description, with reservoir of spermatheca bending 180°, consisting of a slender basal and inflated posterior portion. — ***Male:*** unknown.

Differential diagnosis. Distinguished amongst species of *Peloridinannus* by the elongate body shape, the basal cell very small, the radial, discal, and trapezoidal cells elongate and the radial and discal cells undivided, with vein-tracing areoles on hemelytron present, but areoles within cells absent, and the spermatheca bending at almost 180° (Fig. 8G,I).

Collecting method. AMNH_IZC 00150715 was collected underneath bark and UCR_ENT 00044295 and UCR_ENT 00082164 on a log, indicating that at least females of this species are associated with tree bark.

Etymology. "Steno" from Greek narrow, referring to the elongate body shape of this species together with the species epithet of the type species of *Peloridinannus*. The gender is masculine.

Discussion. Wygodzinsky (1951b) treated a submacropterous *Peloridinannus* female (head and prothrorax missing) from the type locality of *P. margaritatus* (female macropterous holotype) in Costa Rica as belonging to *P. margaritatus*. He indicated that the areoles in this specimen are bigger than those in the macropterous holotype. Based on comparisons made between specimens available now, we conclude that: (1) the areole size appears to be independent of wing type (macroptery or submacroptery) in *Peloridinannus* (see, e.g., *P. moe*) and

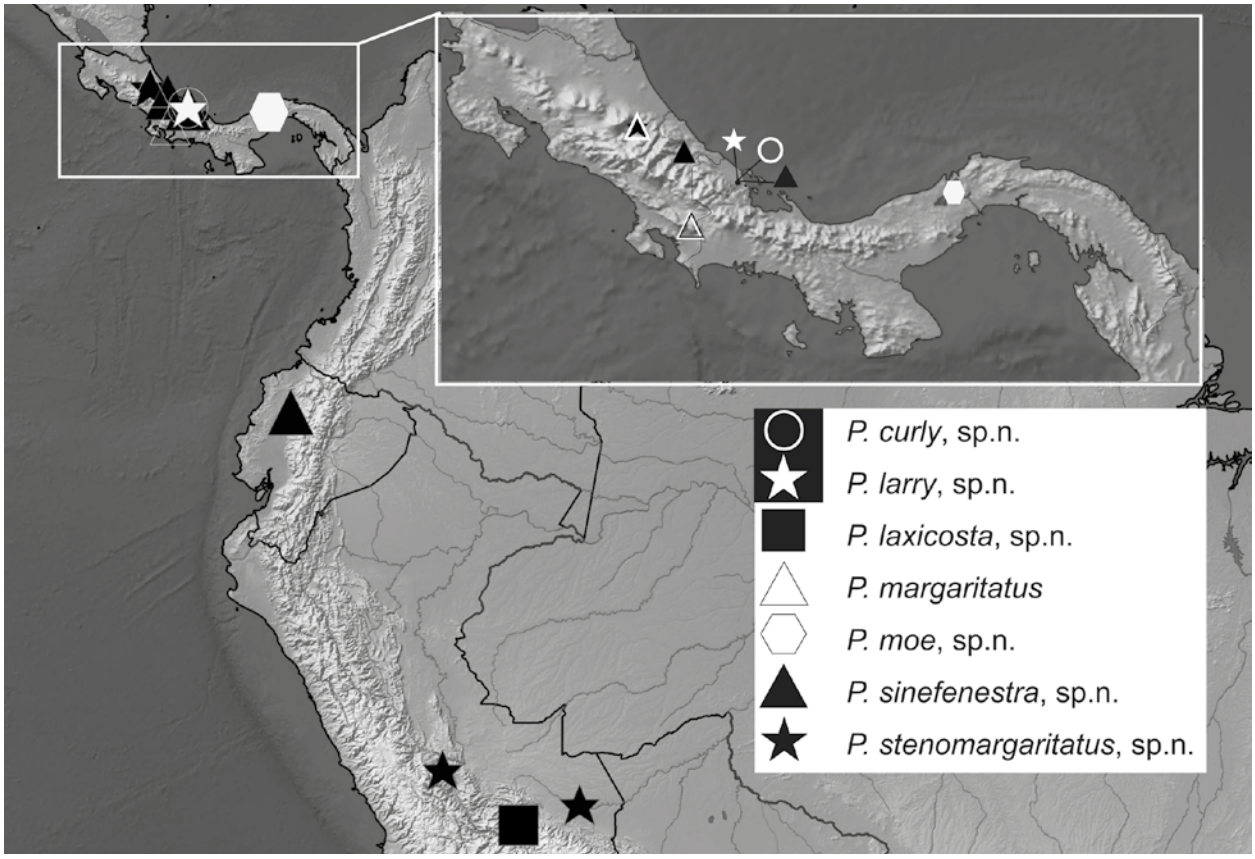

Fig. 10. Known distributions for *Peloridinannus* spp.

the uniformly large areoles are here recognized as a diagnostic feature of *P. stenomargaritatus*. (2) The pattern of wing venation between the submacropterous female from Costa Rica is consistent with the one seen in the three macropterous female specimens of *P. margaritatus* from Peru, and distinctly different from the pattern in males and females of *P. margaritatus* (e.g., subdivision of radial and discal cells in *P. margaritatus*, but not in *P. stenomargaritatus*). (3) The shape of the spermatheca appears to be species-diagnostic in *Peloridinannus*: the submacropterous female from Costa Rica and the two dissected Peruvian females share a spermatheca with narrow and elongate basal portion of the reservoir and a moderately inflated distal portion forming a 180° angle (Fig. 8G,I); the spermatheca in the only known female of *P. margaritatus* (the holotype) has a strongly inflated straight reservoir that is not subdivided into a proximal and distal portion. We therefore transfer the paratype of *P. margaritatus* to *P. stenomargaritatus* sp.n.

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