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RESEARCH ARTICLE

Zunielmis pax, a new genus and species of riffle beetles (Coleoptera: Elmidae) from Colombia

Zunielmis pax – новый род и вид жуков-элмид (Coleoptera: Elmidae) из Колумбии

M. González-Córdoba, V. Manzo & C.E. Granados-Martínez

М. Гонсалес-Кордова, В. Мансо, К.Э. Гранадос-Мартинес

Marcela González-Córdoba, Centro de Investigación Esquel de Montaña y Estepa Patagónica (CIEMEP), CONICET-UNPSJB, Roca 780, Esquel 9200, Argentina; Grupo de Investigaciones Entomológicas, Universidad del Valle, Calle 13 # 100-00, Cali 76000, Colombia. E-mails: mgonzalezcordoba@comahue-conicet.gob.ar, marcela.gonzalez@correounivalle.edu.co

Verónica Manzo, Instituto de Biodiversidad Neotropical (IBN), CONICET-Universidad Nacional de Tucumán, Crisóstomo Álvarez 722, Tucumán 4000, Argentina. E-mail: vmanzo@csnat.unt.edu.ar

Cristian E. Granados-Martínez, Grupo de investigación EBET, Universidad de la Guajira, Km 5 Vía Maicao, Riohacha 440001, Colombia; Doctorado en Ciencias Naturales para el Desarrollo (DOCINADE), Instituto Tecnológico de Costa Rica, Universidad Estatal a Distancia, Costa Rica. E-mail: cegranados@uniguajira.edu.co

Abstract. A new riffle beetle, *Zunielmis pax* **gen.** et **sp. nov.**, is described from Colombia (Vichada, Puerto Carreño, Bita River basin). It can be distinguished from all the other elmids by having large areas of a microgranular mesh (plastron) on the pronotum and elytra, crenulate lateral margin of the latter two, the shorter interocular distance than diameter of each eye, as well as by the characters of the structure of mandibles, the shape and sculpture of pronotum, and the structure of mesosternum, mesotibiae and elytra. The imagoes were collected on freshwater sponges. The habitat, where the new species was found, is described, and the adaptive meaning of the characteristics of plastron are discussed. Drawings and photographs of the adult habitus, distinctive morphological characters, and male and female genitalia are provided.

Резюме. Описан новый представитель элмид, *Zunielmis pax* **gen**. et **sp. nov.**, из Колумбии (Вичада, Пуэрто-Каррено, бассейн реки Бита). От всех других Elmidae он отличается обширными участками микрозернистой сеточки (пластроном) на переднеспинке и надкрыльях, зазубренными боковыми краями последних, более коротким расстоянием между глазами, чем их диаметр, а также признаками строения мандибул, формой и скульптурой переднеспинки и строением мезостернита, средних голеней и надкрылий. Имаго были собраны на пресноводных губках. Описывается местообитание, в котором новый вид был найден, и обсуждается адаптивное значение признаков пластрона. Приводятся рисунки и фотографии общего вида жуков, отличительных морфологических признаков, а также гениталий самцов и самок.

Keywords: riffle beetles, taxonomy, Neotropics, Colombia, Orinoco River basin, freshwater sponges, Coleoptera, Elmidae, Elminae, new genus, new species

Ключевые слова: элмиды, таксономия, Неотропический регион, Колумбия, бассейн Ориноко, пресноводные губки, Coleoptera, Elmidae, Elminae, новый род, новый вид

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Introduction

The diversity of riffle beetles (Elmidae) in South America has been relentlessly explored over the past few years (Manzo, 2013; Jäch et al., 2016). This has allowed to discover and describe at least four new genera and 100 new species during the last decade, especially from Brazil and Argentina where several taxonomists currently work with Elmidae (for example, Martínez-Román et al., 2019; Polizei & Fernandes, 2020). The study of Elmidae has also been carried out in Ecuador, Venezuela and the Guianas (Guiana, French Guiana and Suriname) mostly by coleopterologists from Europe and the United States of America (for example, Maier, 2013; Barr, 2018; Shepard et al., 2020; Linský et al., 2021).

Many other South American countries suffer from poverty of taxonomic studies, and Colombia is one of them. However, ecology of Elmidae has been studied to some extent (for example, Lozano-Bravo et al., 2018; Aguilera-Giraldo & Vásquez-Ramos, 2019; González-Córdoba et al., 2020b) and some studies have looked at the richness of this family to reduce this gap, leading to several new distributional records, mainly for Amazonian genera (for example, Sondermann, 2013; González-Córdoba et al., 2015a, 2015b, 2016a, 2016b, 2019, 2020a, 2020c; Hincapié-Montoya, 2017; Laython, 2017; Hincapié-Montoya & Uribe-Soto, 2018).

Colombia has faced an internal armed conflict for at least half a century, a period in which some natural or rural areas became dangerous to inhabit, visit or conduct scientific exploration (Peco-Yeste & Peral-Fernández, 2006; Yaffe, 2011). In 2016, when a peace process started, a temporary clearance of some natural areas became possible. This stage, among other things, was favorable to the Colombia-BIO Expeditions, a national initiative of the Colombia Science, Technology and Innovation Ministry (MinCiencias), aimed at exploration, generation and use of knowledge in little-known areas and post-conflict territories of Colombia (Trujillo & Lasso, 2017; Expedición BIO, 2021).

In one of twenty Colombia-BIO expeditions, a new monotypic elmid genus was found in a tributary of the Orinoco River in eastern Colombia with abundant unexplored and inaccessible areas. In the present paper, we describe in detail these new genus and species and some peculiarities of its habitat. This is the first description of a new elmid beetle for Colombia in 30 years (Spangler & Santiago, 1991) and it is dedicated to peace, taking into account that all advances in the study and protection of biodiversity can be reversed without Government policies to protect the human rights, nature and peace in Colombia (Cortés-Zambrano, 2016; Ulloa & Coronado, 2016).

Material and methods

The specimens examined were preserved in ethyl alcohol (80%) and deposited in the following collections: Essig Museum of Entomology, Berkeley, USA (EMEC); Instituto de Biodiversidad Neotropical, Tucumán, Argentina (IBN); Museo de Entomología de la Universidad del Valle, Cali, Colombia (MUSENUV); Natural History Museum, London, United Kingdom (NHM); Smithsonian National Museum of Natural History, Washington D.C., USA (NMNH).

Male and female genitalia were extracted and cleared in 80% lactic acid. Microscopic preparations of the head, mouthparts, pronotum, prosternum, proventriculus, legs, elytra, hind wings, abdomen and genitalia were made. The studies were carried out using stereomicroscopes Nikon SMZ 745, Leica S6D, and compound microscopes Nikon Eclipse 200 and Leica DMLB. Photographs were taken with a Nikon DS-Ri1 U3 digital camera adapted to a trinocular stereomicroscope Nikon SMZ1500 and a trinocular microscope Nikon ECLIPSE Ni-U 90 at the Images Laboratory of the Universidad del Valle, Science-Biology Postgraduate Department. Measurements and drawings were made from scale-calibrated photographs. Morphological nomenclature followed Kodada et al. (2016). Wing venation was homologised using terminology from Kukalová-Peck & Lawrence (1993). Maps were made using QGis 2.18.23.

For the comparison, the paratypes of *Tolmerelmis pubipes* (Hinton, 1936) and *Neolimnius palpalis* Hinton, 1939, borrowed from the NHM, were examined. William Shepard (Berkeley) and Marek Linský (Bratislava) provided photographs of *T. pubipes* from Paraguay (EMEC) and specimens in Hinton collection (NHM), respectively. The additional material of *N. palpalis* from Colombia was also examined.

Taxonomy

Order **Coleoptera**

Family **Elmidae**

Subfamily **Elminae**

Genus ***Zunielmis*** González-Córdoba et Manzo, **gen. nov.**
(Figs 1–40)

Type species: *Zunielmis pax* **sp. nov.**

Diagnosis. This genus can be distinguished from other elmids in the Neotropics by the following combination of characters: 1) large areas on pronotum and elytra covered by plastron; 2) pronotum and elytra laterally crenulate; 3) interocular distance shorter than diameter of each eye; 4) mandibular prostheca with three apical teeth; 5) pronotum with anterolateral angles laminar, semicircular and protruded; 6) pronotal disc with two pairs (apical and basal) of feeble longitudinal carinae and a short transverse elevation between them; lateral margins with a pair of longitudinal elevations on each side; 7) prosternal process and mesosternum covering part of pro- and mesocoxae, respectively; 8) mesotibiae of both sexes with tufts of long setae; 9) elytra with shallowly impressed striae formed by rows of large coarse and deep punctures; 10) elytral interval 2 basally with two short puncture rows and a short carina between them; and 11) three long carinae on elytral intervals 3, 5 and 6/7.

Description. Body small (about 1.4 mm in length), oval, oblong, more than twice as long as wide (Figs 1–8). Surface smooth and shiny in appearance, with sparse, recumbent, short, golden setae. Integument microreticulate laterally on coxae, lower margin of hypomeron and prosternum, anterior region of epipleura and lateral areas of meso- and metasternum. Dorsal and ventral large areas covered with fine microgranular mesh (plastron), giving it a pearly iridescence (Figs 20–24). Microgranular mesh present on pronotum, scutellum, elytra, hypomeron, epipleuron, abdominal sterna, sides of pro-, meso- and metasternum, trochanters and femora. Areas without plastron on head, mouthparts, antennae, prosternum anteriorly, coxae, tibiae and tarsi, sutural interval of elytra, and disc of abdominal ventrites 1 and 2 (Fig. 24).

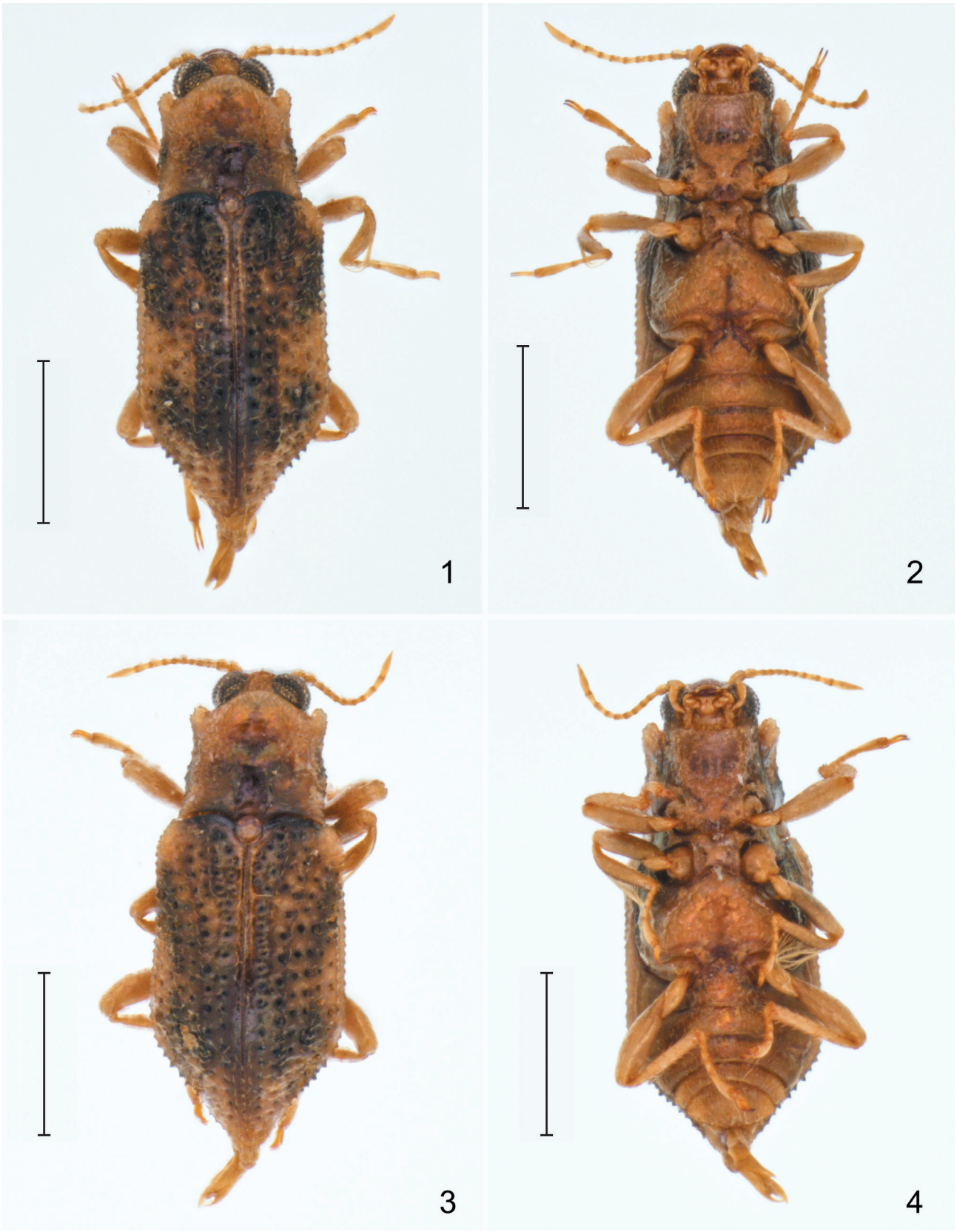
Head (Figs 9–16) strongly retracted into prothorax. Antenna filiform, with eleven antennomeres. Clypeus transverse rectangular. Eyes (Figs 9–11) large and protuberant, their diameter greater than interocular distance. Frons (Fig. 10) elevated between eyes, with a longitudinal carina; vertex imbricate; occipital carina absent. Labrum (Fig. 12) oval, almost as wide as clypeus. Mandibles (Fig. 15) symmetrical, curved, longer than wide, with three rounded apical teeth; mola large, sclerotised; prostheca hyaline, pubescent mesad, anteriorly sclerotised, with three apical teeth. Maxillae (Fig. 16) apically setose, with elongated articles; maxillary palps with four palpomeres. Labial palps (Figs 13, 14) with two palpomeres and palpiger; prementum with an apically setose median lobe between palpomeres; ligula transverse, laterally produced. Mentum wider and longer than submentum, with a pair of anterolateral articulate sensilla. Gula subrectangular.

Proventriculus (Fig. 19) as large as a compound eye, with six groups of spines oriented anteriorly.

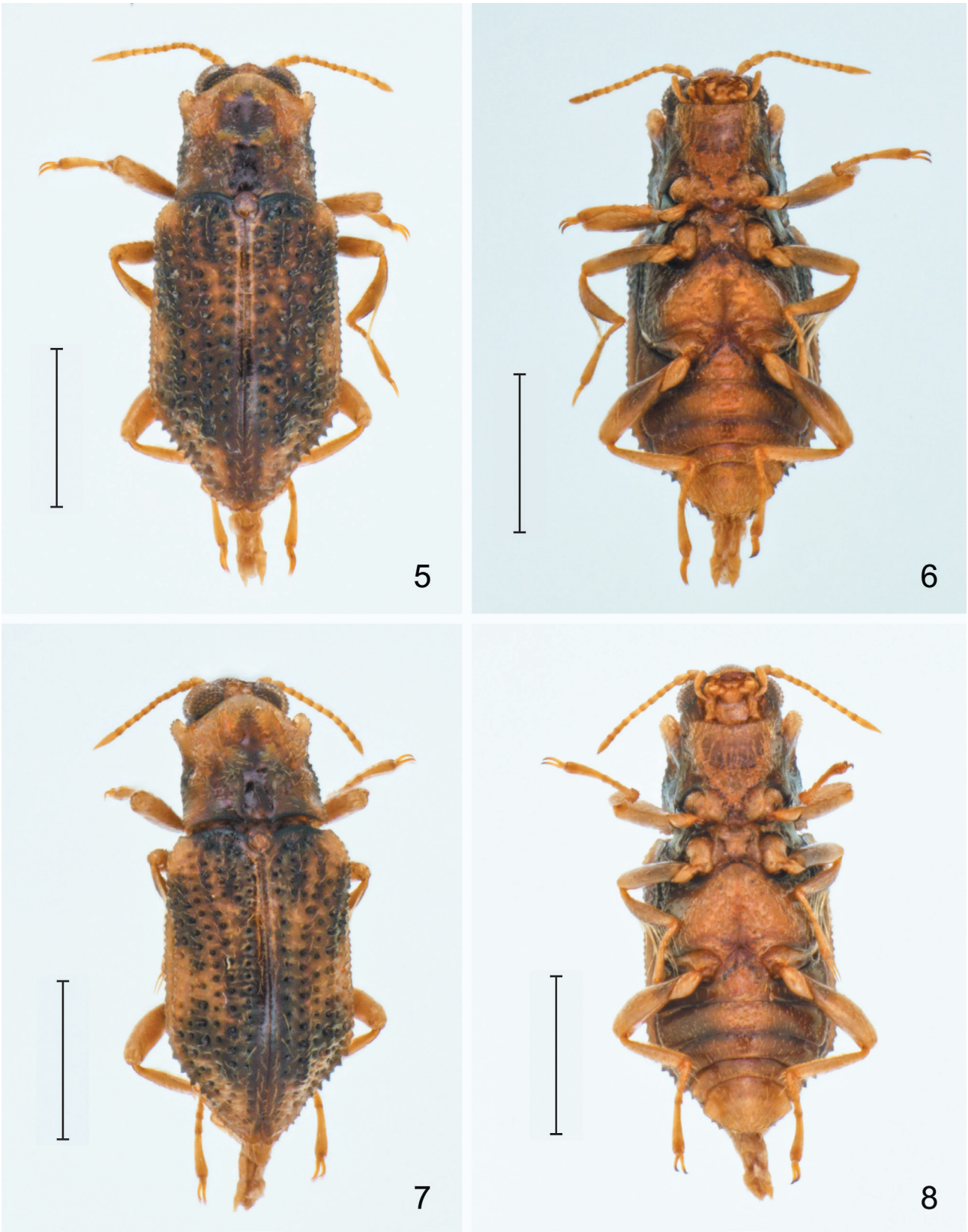
Pronotum (Fig. 36) subquadrate, slightly wider than long, widest at base, with sides sinuous and crenulate. Anterolateral angles laminar, semicircular and protruded. Disc with a short transverse elevation and paired feeble longitudinal carinae; lateral margins with a pair of elevations or gibbosities on each side.

Scutellum flat, subcircular, notched at anterior corners in front of each elytron.

Elytron (Figs 25, 26, 35) elongate, three times as long as wide, crenulate laterally and tuberculate apically, with humerus feebly gibbous and humeral angle not strongly produced. Elytral intervals nearly flat; striae shallowly impressed, formed by longitudinal rows of large coarse and deep punctures. Seven complete and four incomplete puncture rows on each elytron; incomplete puncture rows: two short as accessory striae in basal fifth of interval 2, one in distal half of interval 5 dividing it into two intervals, and one in basal half of outermost interval next to epipleuron. Four carinae defined on intervals 2, 3, 5 and 6/7: a short carina between accessory basal striae; remaining three carinae long, reaching apical quarter; outermost carina separated from carina on interval 5 by a single puncture row at base and two rows at apex, appearing basally on interval 6 but apically on



Figs 1–4. *Zunielmis pax* **gen.** et **sp. nov.**, male, habitus. **1, 2**, holotype; **3, 4**, paratype. Dorsal (1, 3) and ventral (2, 4) views. Scale bars: 0.5 mm.



Figs 5–8. *Zunielmis pax* **gen.** et **sp. nov.**, female, habitus. **5, 6**, allotype; **7, 8**, other paratype. Dorsal (5, 7) and ventral (6, 8) views. Scale bars: 0.5 mm.

interval 7. Epipleuron almost completely smooth, basally tuberculate, without puncture rows, with four lateral lobes each in front of metasternum and abdominal ventrites 1, 2 and 3.

Hind wings as illustrated (Figs 27, 37), longer than body, their distal part longer than proximal part, surface densely covered with setae, posterior margin with a row of setae, venation weak and reduced, cells open, anal veins unbranched or fused to cubital.

Thoracic venter (Figs 2, 4, 6, 8, 17, 18). Prosternum (Fig. 18) longest among thoracic sterna, slightly longer than wide, with anterior margin produced; prosternal carinae present basally; prosternal process subpentagonal, slightly wider than long, with lateral angles protruding above procoxae. Mesoventrite shortest, with a deep medial cavity to accommodate prosternal process; disc subquadrate, protruding laterally above mesocoxae. Metaventrite slightly shorter than prosternum, disc not carinate.

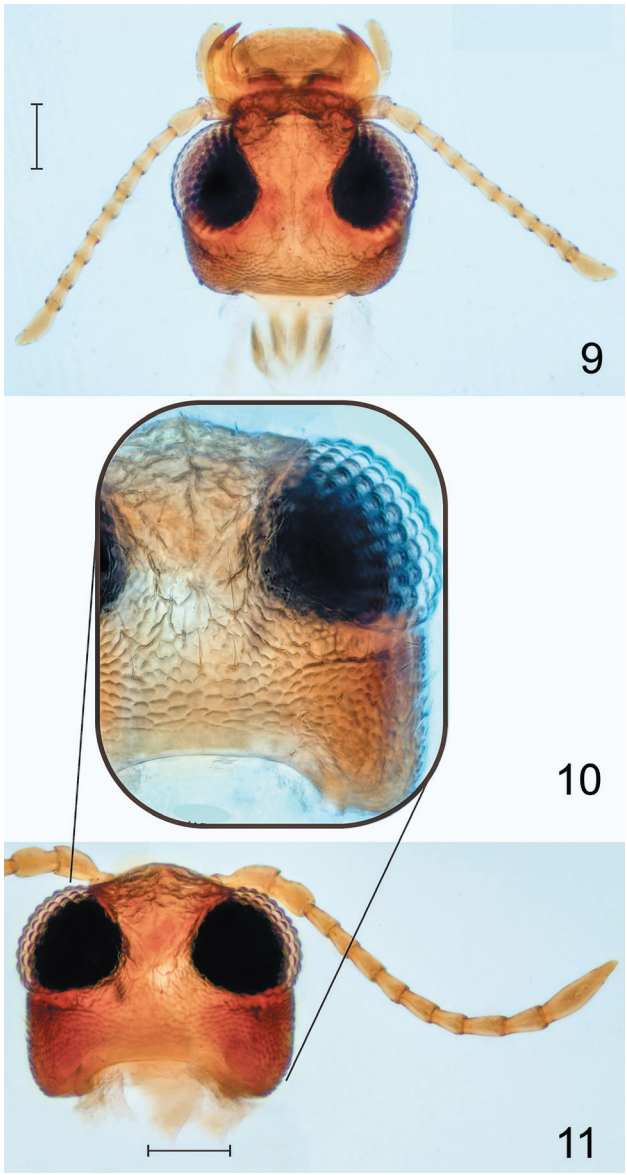
Legs (Figs 29–31). Prothoracic leg shortest, metathoracic leg longest and largest. Pro- and mesocoxa globose, metacoxa transverse, fitting into emargination of abdominal ventrite 1. Femora dorsally armed with a row of spine-like setae, inner face of mesofemur with a basal brush of long simple setae. Tibial cleaning fringes indistinguishable, but a comb of strong recumbent spine-like setae present on ventral margin of tibiae; mesotibia dorsally with a tuft of conspicuous long setae. Tarsi ventrally with spine-like setae; claws long, simple, almost straight.

Abdomen (Fig. 28) with five visible ventrites, each wider than long. Ventrite 1 without discal carinae. Ventrite 5 internally with a striated oval apodeme on each side.

Male genitalia (Figs 33, 38–40). Trilobate typical form, fibula present, phallobase with two oblique asymmetrical basal apophyses.

Female genitalia (Fig. 32). Feebly sclerotised; ovipositor symmetrical; bursa copulatrix sacculiar; valvifers/paraprocts separated mesally, with paraproct baculum well sclerotised; gonocoxites closely conical, emarginated in front of bursa copulatrix and transversally divided into two parts; stylus short, with apical sensilla conspicuous.

Sexual dimorphism. Male and female are similar externally, no sexual dimorphism is noticeable.



Figs 9–11. *Zunielmis pax* **gen**. et **sp. nov.**, head, dorsal view. **9**, female; **10, 11**, male, with magnified view of vertex and interocular area (11). Scale bars: 0.1 mm.

Comparative notes (Table 1). *Zunielmis* **gen. nov.** is similar to *Amazonopsis* Barr, 2018, *Anommatelmis* Spangler, 1981, *Stegoelmis* Hinton, 1939, *Stenhelmoides* Grouvelle, 1908, *Pagelmis* Spangler, 1981, *Portelmis* Sanderson, 1953 and *Xenelmis* Hinton, 1936 in having the dorsal plastron and edentate claws, but differs in having: 1) lateral body margins crenulate and elytral apices conspicuously tuberculate, 2) mesotibiae with tufts of long setae, and 3) elytron with long carinae on intervals 3, 5 and 6/7 and a short basal carina between accessory striae on interval 2.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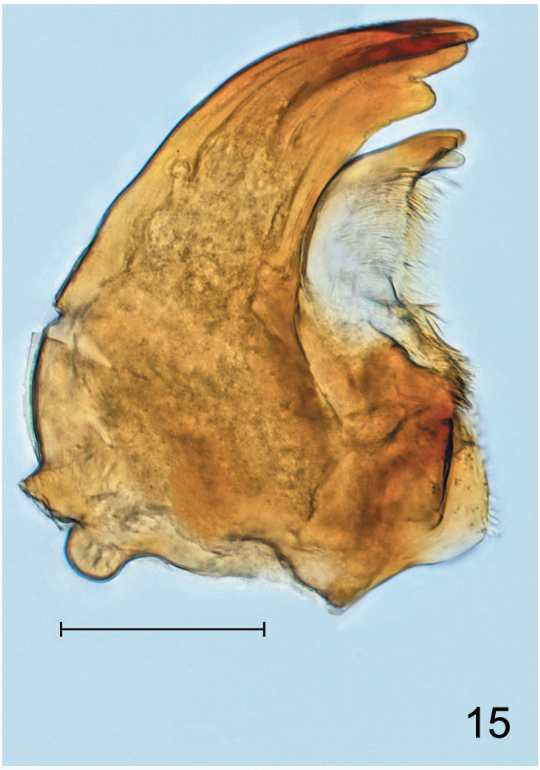
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Table 1. The state of distinguishing characters in *Zunielmis* **gen. nov.** and other genera of Elmidae in Neotropics. x – character presence, s – present in some species.

Character	*Zunielmis*	*Tolmerelmis*	*Neolimnius*	*Portelmis*	*Stegoelmis*	*Stenhelmoides*	*Pagelmis*	*Xenelmis*	*Oolimnius*	*Amazonopsis*	*Anommatelmis*
Dorsal plastron	x	x	x	x	x	x	x	x	x	x	x
Light/dark colour patterns	x	x	x	s	x	s	x				
Pearly iridescence	x	x	x	s					x		
Large eyes and facets	x	x	x	x	x	x	x	s		x	
Frons carinate	x		x				x				
Genae lacking plastron	x	x	x		x			x	x		
Body margins crenulate	x	x	x					x	x		
Anterolateral angles of pronotum laminar and semicircular	x										
Prosternal process expanded over procoxae	x	x				x		x	x		
Mesosternum expanded over mesocoxae	x	x				x		x	x	x	
Metaventrite not carinate	x		x	x	x	x	x	x	x	x	x
Abdominal ventrite 1 not carinate	x		x	x	x	x	x	s	x	x	x
Mesotibiae with tufts of long setae	x	x									
Tibial cleaning fringes absent	x		x		s		x				
Comb of spine-like setae instead tibial cleaning fringes	x		x	x	s	s	x		x		x
Tarsal claws not toothed	x	x	x	x	x	x	x	x	x	x	x
Elytron carinate	x	x	x					x	x		x
Elytron with two short basal striae on interval 2	x	x									
Elytral apices tuberculate	x	x									

The new genus is also similar to *Neolimnius* Hinton, 1939 and *Tolmerelmis* Hinton, 1972. They have in common the crenulate pronotal and elytral lateral margins, relatively large eyes with large facets, distinct carinae on the elytra, a pearly iridescence that Hinton (1972) marked as "metallic lustre", which is produced by the plastron microstructure. *Zunielmis* **gen. nov.** and *Neolimnius* are also similar in having combs of spine-like setae on the tibiae instead of cleaning fringes, the elytral intervals 3 and 5 carinate, and the head bearing a longitudinal median carina. These two genera differ in that the lacinia and galea of *Zunielmis* **gen. nov.** are rounded (instead of straight) and shorter than in *Neolimnius*; in addition, in the latter genus, the lateral margins of prosternal process and the mesosternum are not expanded over coxae, and the long setae on the mesotibia are absent.

Tolmerelmis and *Zunielmis* **gen. nov.** share more characters: the lateral margins of prosternal process and mesosternum expanded, mesotibia with long setae, and elytral interval 2 with two accessory basal striae. *Zunielmis* **gen. nov.** can be distinguished from *Tolmerelmis* by lacking carinae on the metaventrite and abdominal ventrite 1 and having the pronotum with a transverse elevation and rounded anterolateral angles. In addition, Hinton (1972) reports the tibial cleaning fringes

Figs 12–16. *Zunielmis pax* **gen.** et **sp. nov.**, mouthparts. **12**, labrum; **13**, ligula; **14**, labium; **15**, mandible; **16**, maxilla. Dorsal (12, 13, 15) and ventral (14, 16) views. Scale bars: 50 μm.

in *Tolmerelmis* are in the formula 2-2-1, while in *Zunielmis* **gen. nov.** they present combs of spine-like setae in the formula 1-2-1.

Etymology. The generic name is a combination of two stems: "Zuni", deriving from Zúñiga, after Dr María del Carmen Zúñiga, appreciated scientist and professor at the Universidad del Valle, a pioneer in the taxonomic study of Elmidae in Colombia and a mentor for study of Neotropical Plecoptera and other aquatic insects, and *Elmis*, the name of the type genus of Elmidae. Gender is feminine.

Remarks. The following modifications to the existing keys for genera of Elmidae of South America and the Neotropics should be included.

Key to the genera of the subfamily Elminae of Neotropics (Passos et al., 2018: 589):

7(6) Elytron without basal accessory striae 9
7' Elytron with one or two short accessory striae 8
8(7) Elytron with one short accessory stria ..... *Macrelmis*
8' Elytron with two short basal striae ..... *Zunielmis* **gen. nov.**

Key to the genera of the subfamily Elminae of South America (Manzo, 2005: 206):

6. Elytra with one or two short accessory striae between striae 1 and 2 7
– Elytra without basal accessory striae 8
7. Elytra with a short accessory stria between striae 1 and 2 ..... *Macrelmis*
– Elytra with two short basal striae laterally of stria 1 ..... *Zunielmis* **gen. nov.**

Key to the genera of the subfamily Elminae of South America (Archangelsky et al., 2009: 452):

6 (5) Élitros con una o dos estrías accesorias entre la primera y segunda estría 7
Élitros sin estrías accesorias 8
7 (6) Élitros con una corta estría accesoria entre la primera y segunda estría ..... *Macrelmis*
Élitros con dos estrías basales cortas después de la segunda estría ..... *Zunielmis* **gen. nov.**

Zunielmis pax González-Córdoba et Manzo, **sp. nov.**
(Figs 1–40)

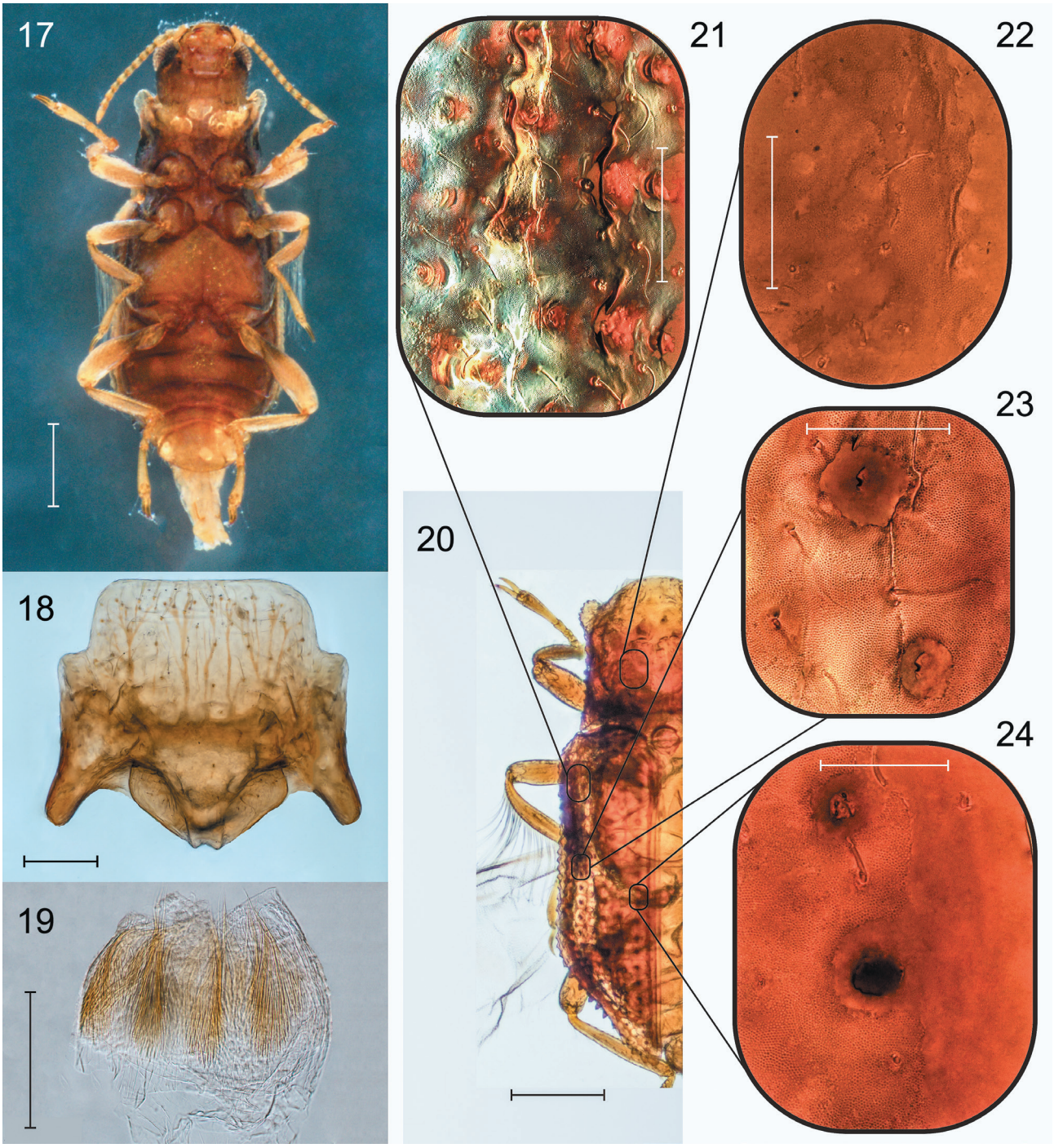
Holotype. Male, **Colombia**, *Vichada*, Puerto Carreño, Bita river basin, Anakay window E12, 5°50′34.4″ N 68°44′31.8″W, 130 m a.s.l., Febr. 2016, at sponge, C. Granados-Martínez leg. [29928] (MUSENUV).

Paratypes. Allotype, female, same data as for holotype [29954] (MUSENUV); 4 males, 4 females, same data as for holotype (IBN, MNH, NMNH, EMEC).

Description. Holotype, male (Figs 1, 2). Body length 1.44 mm, width 0.58 mm.

Integument shiny, with pearly iridescence, brownish yellow to reddish brown, with dark brown to black patterns on pronotum and elytra. Lighter areas on head, antennae, mouthparts, anterolateral angles of pronotum, scutellum, humeral angles, basal half of sutural interval, lateromedial and apical areas of elytra, legs, thoracic and abdominal sterna, and epipleura. Darker areas ventrally lateral to pro- and mesocoxae including posterior half of hypomeron, dorsally on pronotal disc, basomedial and lateromedial areas, on elytra at base, posterior half of disc, near humeri between two outermost carinae, and near apex between intervals 3 and 7. Surface covered with fine, recumbent setae as long as two ocular facets. Microgranular mesh (plastron) (Figs 21–24) on: pronotum except longitudinal discal stripe, scutellum, elytra except sutural interval, epipleura, pro-, meso- and metasternum laterally, hypomeron, trochanters, femora, abdominal sterna except disc of ventrites 1 and 2.

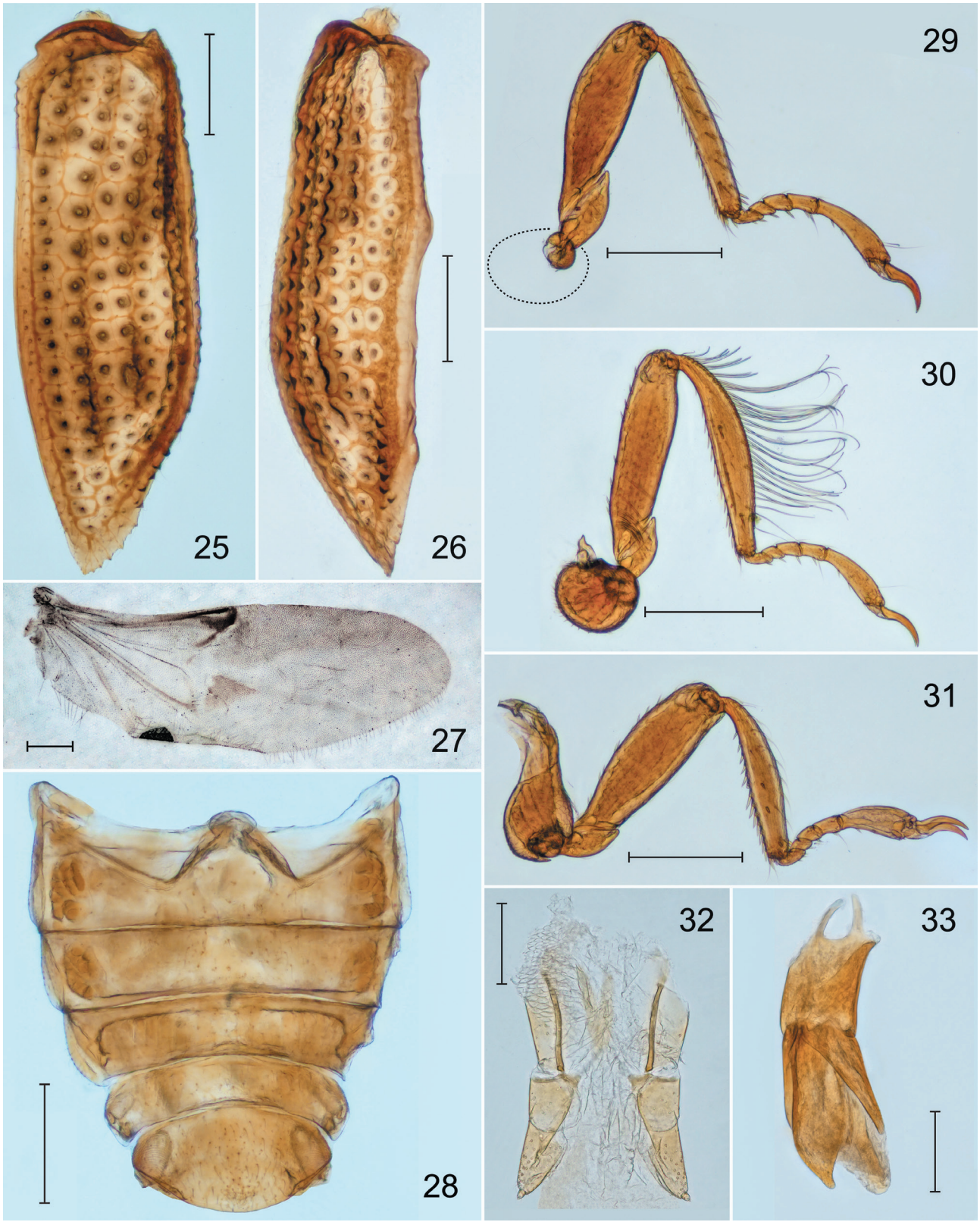
Head (as in Figs 9–11). Surface rough, with small anteriorly directed recumbent setae; genal and occipital area imbricate, covered with spine-like setae, without plastron. Longitudinal median carina between eyes not reaching posterior or anterior margin. Interocular distance less than eye width. Diameter of ocular facets one-third length of antennomere 3. Antennal insertions between eyes and clypeus, close to frontoclypeal suture. Antennomeres striate, scape slightly longer than pedicel, antennomere 11 longest, apically pointed, as long as antennomeres 9 and 10 together. Frontoclypeal suture straight. Clypeus wider than labrum, with distal margin almost straight and anterolateral angles rounded. Labrum longer than clypeus, with lateral margins entire and rounded; its distal margin with short setae converging medially, anterolateral angles with longer setae. Maxillary palp as long as rest of maxilla, cardo longer than stipes, lacinia longer than galea and terminal palpomere. Labial palpomeres subequal in length, prementum longer than mentum, lobed between palps, ligula short



Figs 17–24. *Zunielmis pax* **gen.** et **sp. nov. 17**, specimen immersed in alcohol, ventral view; **18**, prosternum; **19**, proventriculus; **20**, reference habitus in polyvinyl alcohol-lactic acid-glycerol (PVLG), dorsal view; **21–24**, microgranular mesh (plastron), on pronotum (22), elytron laterally (21, 23) and sutural interval (24). Scale bars: 0.3 mm (17, 20), 0.1 mm (18, 19), 50 µm (21, 22), 30 µm (23, 24).

and setose, mentum with sides diverging anteriad, submentum transverse, hypopharynx anteriorly transverse, with anterolateral angles covered with stout setae.

Pronotum (as in Fig. 36) subquadrate, slightly wider than long (length 0.40 mm, middle width 0.44 mm, maximum width at base 0.45 mm). Anterior margin projected beyond anterolateral



Figs 25–33. *Zunielmis pax* **gen.** et **sp. nov. 25, 26**, elytron, ventral (25) and right lateral (26) views; **27,** hind wing; **28**, abdomen, ventral view; **29–31**, legs, fore (dotted line marking missing procoxa) (29), middle (30), and hind (31); **32**, ovipositor, ventral view; **33**, aedeagus, dorsolateral view. Scale bars: 0.2 mm (25–31), 0.1 mm (32, 33).

angles. Anterolateral angles as wide as half eye width. Posterior margin emarginate in front of scutellum and elytra. Disc smooth, with a depressed nearly circular anterior area, two pairs of feeble longitudinal carinae; an apical pair forming a circle in anterior third and a basal pair in posterior quarter, and a short transverse medial elevation one-third as wide as pronotum, separating basal and apical carinae. Lateral stripes tuberculate, with a pair of longitudinal elevations on each side, outermost longest.

Scutellum as long as wide (0.08 mm).

Elytra (as in Figs 25, 26, 35) elongate (length 1.02 mm, maximum width near apex 0.60 mm and at base 0.57 mm), basally one-quarter wider than pronotum. Lateral margins tuberculate, tubercles larger than ocular facets, blunt and wider than long at elytral base, and sharp, longer than wide at elytral apex. Each puncture of elytral striae as large as an ocular facet and distanced of three to four diameters from each other. Two short subequal-in-length rows of four to five punctures as accessory striae on interval 2. Interval 6 distally divided into two parts by a row of ten punctures starting almost in middle. Elytral carinae formed by raised granules, carina on interval 2 between accessory striae as long as these striae, carina on interval 3 reaching apical fifth. Two outermost carinae starting together in humeral area, separated basally by a single row of punctures, apically by two rows. Carina on interval 5 slightly shorter than carina on interval 3. Carina on interval 6/7 parallel to lateral margin of elytron. Epipleuron basally covered by metepisternum.

Hind wings (as in Figs 27, 37) with dark patches on RA_{1+2}, RA_{3+4}, radial cell and r_3, a large anterior distal area and a subtriangular area in front of *RP* and MP_{1+2} apex.

Thoracic venter. Prosternum (as in Fig. 18) anteriorly projected beyond anterolateral angles of pronotum, anterior margin straight with rounded lateral angles. Prosternal carinae feeble and short in basal half. Prosternal process apically rounded and with an inconspicuous emargination. Hypomeron depressed mesally. Prosternal process, meso- and metaventrite with posteriorly directed recumbent golden setae. Mesoventrite anteriorly with a cleft one-third as wide as prosternal process, posteriorly emarginate in front of metasternum. Metaventrite almost twice as long as wide, with disc subtriangular and lacking carinae, discrimen present in posterior half. Metepisternum produced on epipleura.

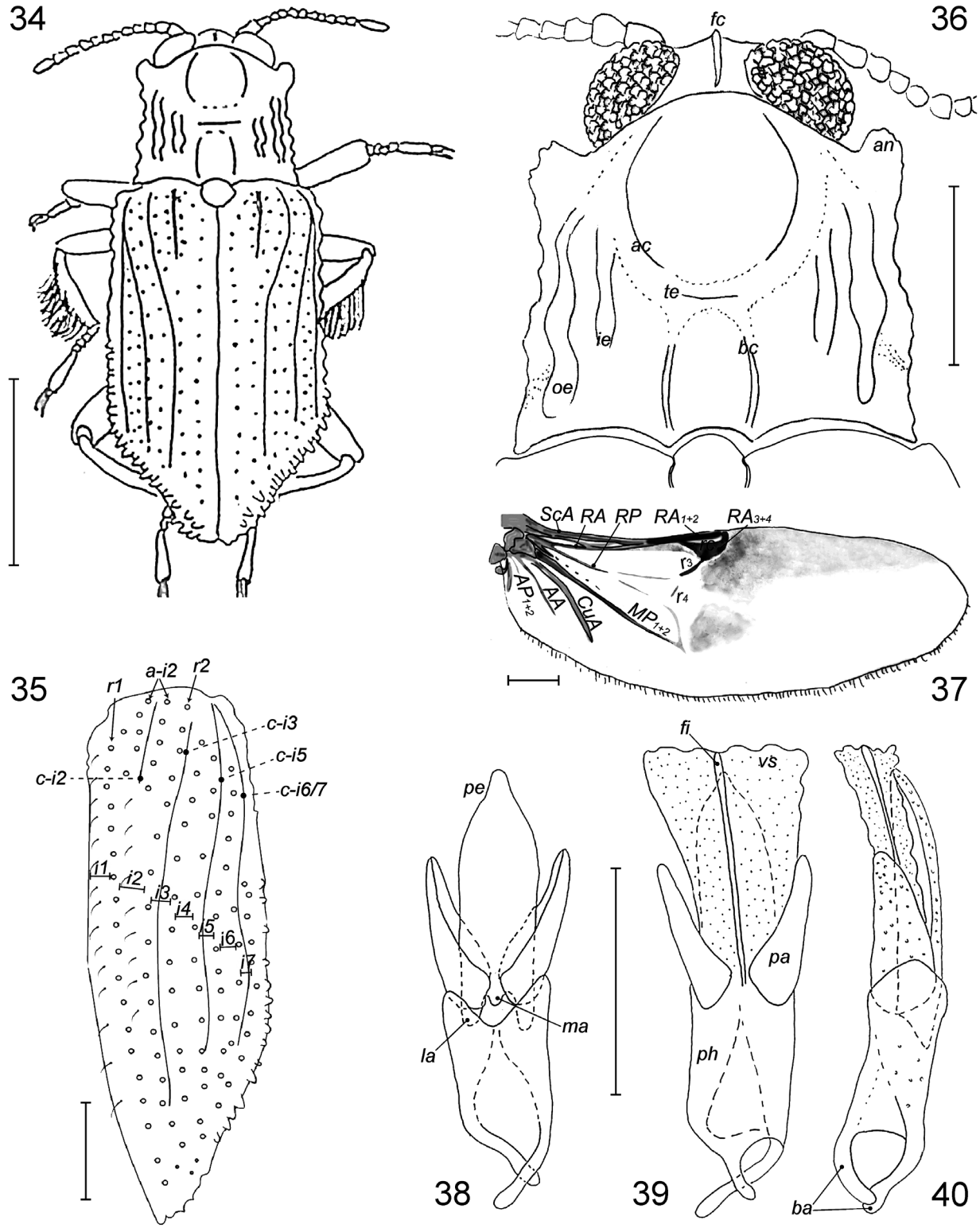
Legs (as in Figs 29–31). Coxae larger than trochanter, metacoxa as wide as length of metatarsus. Trochanters fusiform. Femora longer than tibiae. Tibiae apically with stout spine-like setae around tarsus, ventral rows of comb-like setae in formula 1-2-1. Tarsomeres each ventrally with one or two spine-like setae. Tarsomere 5 longest, shorter than tarsomeres 1–4 together, dorsally with an apical long seta. Claws as long as tarsomeres 1–3 together.

Abdomen (as in Fig. 28) with sparse, small punctures and posteriorly directed setae. Ventrite 1 twice as wide as ventrite 5. Posterior margin of ventrites 1 and 2 nearly straight, ventrites 3 and 4 posteriorly convex, ventrite 5 suboval, with posterior margin entire and rounded, and lateral margins angular.

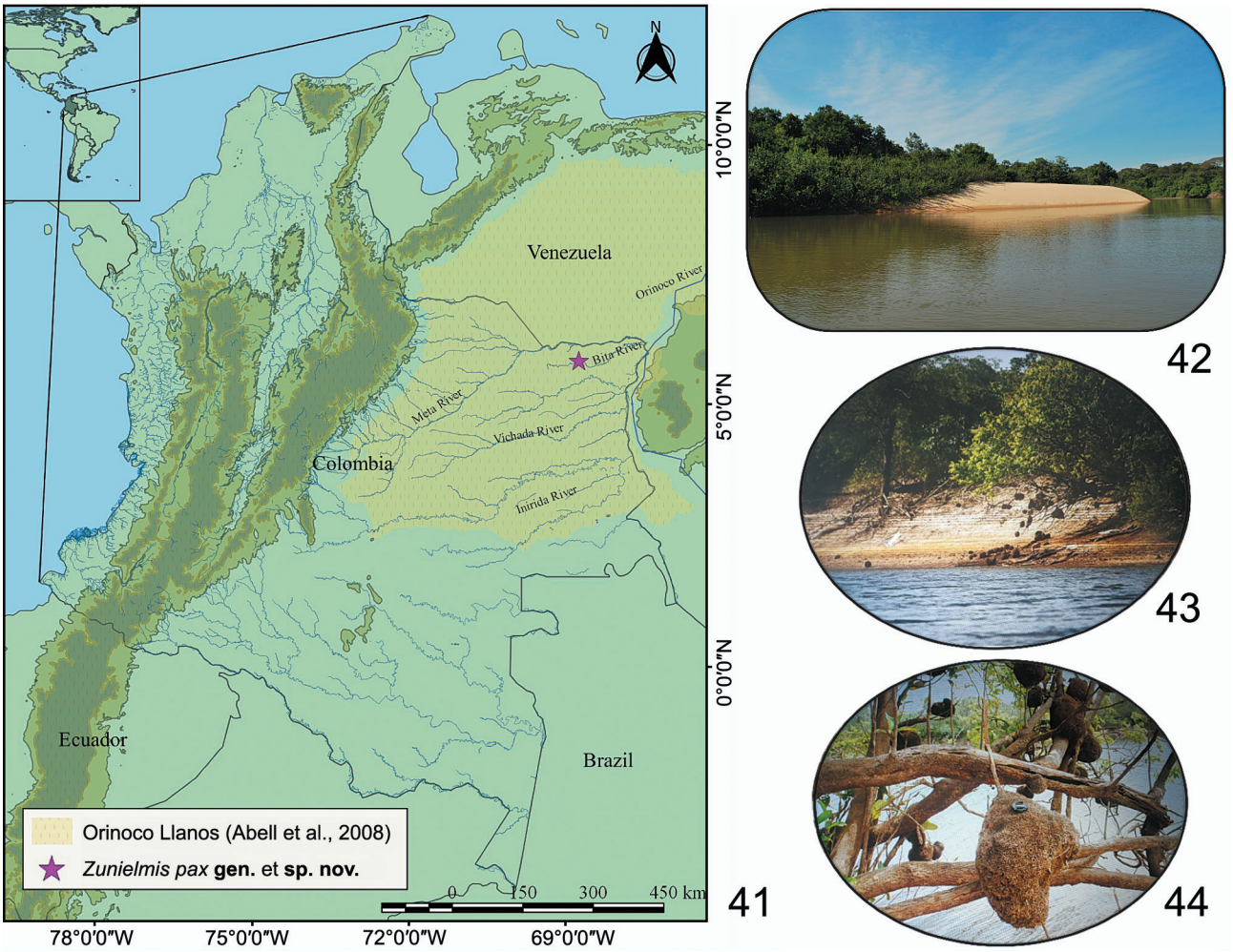
Aedeagus (as in Figs 33, 38–40) longer than abdominal ventrite 5, not curved in lateral view. Phallobase as long as penis, closed, basally with two opposed curved apophyses. Parameres subtriangular, one-third length of penis. Penis parallel-sided, narrowed apically; basolateral apophyses three times as long as median apophyse. Membranous ventral sac extending beyond penis apex, with strongly sclerotised fibula.

Female (allotype) externally (Figs 5, 6) similar to holotype. Length 1.44 mm, width 0.58 mm. Ovipositor (Fig. 32) longer than abdominal ventrite 5, slightly flattened dorsoventrally, with sparse pores bearing short setae, more setose at apex. Gonocoxite subtriangular, with apical part longer than basal. Gonostyle rounded, with multiple apical sensillae. Paraproct shorter than gonocoxite.

Variation. Individuals vary in size and colouration (Figs 1–8). Females are slightly larger than males on average: in females, length 1.41–1.64 mm (mean 1.49 mm) and width 0.60–0.64 mm (mean 0.61 mm); in males, length 1.36–1.47 mm (mean 1.44 mm) and width 0.53–0.61 mm (mean 0.58 mm). Major colour variations include darkening of some areas such as apices of mandibles and claws, femoral base, elytral intervals, pronotal



Figs 34–40. *Zunielmis pax* **gen.** et **sp. nov.**, scheme of diagnostic characters. **34**, habitus, dorsal view; **35**, elytron; **36**, head and pronotum; **37**, hind wing; **38–40**, aedeagus, dorsal (38), ventral (39) and left lateral (40) views. Abbreviations: *a-i2*, accessory striae of interval 2; *ac*, apical carina; *an*, anterolateral angle; *ba*, basal apophyses;



Figs 41–44. *Zunielmis pax* **gen.** et **sp. nov.,** distribution and habitats. **41**, distribution map; **42, 43**, Bita river; **44**, sponge.

and prosternal sides, and lightening of some areas such as elytral apex, sutural elytral interval, humeral region and epipleura. In some individuals, ventral carinae and emargination of prosternal process are feebly developed, and anterior margin of prosternum does not reach apex of anterolateral angles of pronotum. Pronotal carinae and sublateral elevations as well as elytral carinae are more or less defined, depending on the individual.

Etymology. The specific name is a Latin noun meaning "peace" and given because research and conservation of biodiversity in Colombia depend largely on peaceful scenarios, including a ceasefire, equity, social justice, rights protection and tolerance for differences.

Distribution (Fig. 41). Known only from Colombia (Bita River basin, Puerto Carreño, Vichada).

Habitat. The only record of *Z. pax* **sp. nov.** was in a wetland produced by periodic flooding of the Bita River (Figs 42, 43), which in turn flows into the Orinoco River. This region is known as Orinoco Llanos (Abell et al., 2008; FEOW, 2019). The Bita is a pristine river with a low sediment load, a predominant landscape of Guyanese plains

bc, basal carina; *c-i2*, *c-i3*, *c-i5*, *c-i6/7*, carinae of intervals 2, 3, 5, and 6/7, respectively; *fc*, frontal carina; *fi*, fibula; *i1*, *i2*, *i3*, *i4*, *i5*, *i6*, *i7*, intervals 1, 2, 3, 4, 5, 6, and 7, respectively; *ie*, inner elevation; *la*, basolateral apophyse; *ma*, basomedial apophyse; *oe*, outer elevation; *pa*, paramere; *pe*, penis; *ph*, phallobase; *r1*, puncture row 1 (stria 1); *r2*, puncture row 2; *te*, transverse elevation; *vs*, membranous ventral sac. Scale bars: 0.5 mm (34), 0.2 mm (35–40).

(< 200 m a.s.l.), warm temperatures (27–28 °C on average), and unimodal rains with a rainy season from April to November and a dry period from December to March, which affects the presence and abundance of aquatic species (Trujillo & Lasso, 2017). The Bita River was sampled in 22 stations, *Z. pax* **sp. nov.** was found only at one of them in Anakay window. This station had the following conditions: oligotrophic waters, dissolved oxygen 7.0 mg/L, slightly acidic with a pH of 6.9, a water temperature of 28.4 °C, dissolved solids at 3.5 ppm and a low conductivity of 5.0 µS/cm (Granados-Martínez & Montoya, 2017).

Remarks. The beetles of *Z. pax* **sp. nov.** were found only on sponges (Porifera) (Fig. 44). *Drulia* Gray, 1867 and *Metania* Gray, 1867 (Metaniidae) are genera of freshwater sponges, recorded in sampling area. These are very abundant elements in the floodplain landscapes of the Guiana Shield in Colombia, including the Bita River basin, and they are colonised and used by different types of organisms, such as aquatic insects (Lasso et al., 2017). Species of the elmid genera *Hintonelmis* Spangler, 1966, *Cylloepus* Erichson, 1847, *Neoelmis* Musgrave, 1935 were found together with *Z. pax* **sp. nov.** on the sponges. *Hintonelmis sul* Hinton, 1971 and *Stegoelmis stictoides* Spangler, 1990 were found in the same locality, but on submerged trunks. Granados-Martínez & Montoya (2017) also recorded species of *Microcylloepus* Hinton, 1935 and *Hexanchorus* Sharp, 1882 in the Bita River basin during the low-water season.

The water-repellent structures of the plastron have been named plastron setae/hairs, but they can consist of different types: either flattened hair-like, scale-like or radial spiculate setae, microtrichial mesh, porous sheet-like layer (Leschen et al., 2016), or even cuticular secretions/exudate and possibly granular microstructures (Hinton, 1972; Spangler, 1981a, 1981b). In this work, a microgranular type of plastron is found in *Zunielmis* **gen. nov.**, which produces a pearly iridescence (Figs 20–24). The iridescence occurs because of the light diffraction in a uniform mosaic of microgranular structures. This can be an indicator of the plastron microstructure, when it is not possible to see it through a microscope (1000× or more). No in vivo test has been performed to verify if this microstructure retains air, but waterproofing by a very thin layer was observed in specimens preserved in alcohol, while drying.

A flattening and lessening of plastron individual structures (from hairy/setose to squamous/flattened) has also been observed, especially in Amazonian Elmidae (Hinton, 1976). This would decrease their ability to retain more air per area unit (Thorpe & Crisp, 1947; Thorpe, 1950). Thus, this group of organisms can be favored by the presence of a dorsal plastron as compensation for a reduced air volume by an increase in the plastron surface area.

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