Nanelmis Barr, a New Genus of Diminutive Riffle Beetle (Coleoptera: Dryopoidea: Elmidae: Elminae) from South America with Two New Species

Authors: Barr, Cheryl B., Arteaga, Zunilda Escalante, and Cerdan, Axel

Source: The Coleopterists Bulletin, 79(3) : 351-368

Published By: The Coleopterists Society

URL: https://doi.org/10.1649/0010-065X-79.3.351

The Coleopterists Bulletin 79(3): 351–368. 2025.

Nanelmis Barr, a New Genus of Diminutive Riffle Beetle (Coleoptera: Dryopoidea: Elmidae: Elminae) from South America with Two New Species

Cheryl B. Barr*
Essig Museum of Entomology
1101 Valley Life Sciences Bldg.
University of California
Berkeley, CA 94720, USA
cbarr@berkeley.edu
https://orcid.org/0000-0001-6707-4301
*Corresponding author

Zunilda Escalante Arteaga
Alianza para una Amazonía Sostenible Perú
Parcela 4, Sector Monterrey
Madre de Dios, PERU
zunilda.escalante@sustainableamazon.org
https://orcid.org/0000-0002-4266-9592

and

Axel Cerdan
Hydreco Guyane
Laboratoire Environnement
12, Rue Gustave Eiffel - ZI Pariacabo
BP 823 -97388 Kourou Cedex, FRENCH GUIANA
axel.cerdan@hydrecolab.com
https://orcid.org/0000-0002-5195-3720

Abstract

Nanelmis Barr, **new genus** with two new species, *Nanelmis aguaje* Barr, **new species** from Peru and *Nanelmis longicruris* Barr, **new species** from French Guiana, are diagnosed, described, and illustrated, as is the larva of *N. aguaje.* Adult specimens of both species are tiny, less than 2 mm long. Despite the fact that a fairly large series of *N. aguaje* was collected, all are female. *Nanelmis longicruris* is described from a single male which has modifications that are likely due to sexual dimorphism. Each species is known from a single locality, both of which are described in detail.

Keywords: aquatic beetles, streams, aguaje palm swamp, Neotropics, French Guiana, Peru, taxonomy

DOI.org/10.1649/0010-065X-79.3.351
Zoobank.org/urn:lsid:zoobank.org:pub:D3A9DFDC-436E-4C4E-A4DE-1D12F431DE37

Introduction

The cosmopolitan family Elmidae is represented in the Neotropics by over 50 genera and approximately 500 species (Jäch *et al*. 2016). South America is a hotspot of elmid biodiversity with many undescribed taxa, and there is currently a renewed taxonomic interest in the family there by researchers. During the past 15 years, seven new genera—*Hypsilara* Maier and Spangler, 2011; *Elachistelmis* Maier, 2012; *Amazonopsis* Barr, 2018; *Ictelmis* Čiampor, Linský, and Čiamporová-Zaťovičová, 2019; *Zunielmis* González-Córdoba, Manzo, and Granados-Martínez, 2021; *Rumilara* Linský, Čiamporová-Zaťovičová, Laššová, and Čiampor, 2022; *Spanglerelmis* Polizei and Bispo, 2022—and many new species have been described from South America.

The larvae of South American Elmidae are much more poorly known than the adults. Manzo and Archangelsky (2008) documented the taxa for which larvae had been described and published a key to the known genera. Other important articles focusing broadly on elmid larvae include: Segura *et al*. (2011), on the elmid larvae of Sao Paulo, Brazil, with a key to 12 genera, including three unassociated

morphotypes; Shepard *et al.* (2020), on the elmid larvae of French Guiana with a key to 16 genera, including five unassociated morphotypes, and two new adult-larval associations; and González-Córdoba *et al.* (2020), with description of the larva of *Stenhelmoides* Grouvelle and a thorough overview of the state of knowledge of Neotropical elmid larvae. González-Córdoba *et al.* (2020) provided a table of 48 described genera showing that 17, or 35%, did not have described or associated larvae. Since then, three new genera and five larvae have been described or associated, so presently 15 genera lack a larval association.

A single specimen of a new genus was discovered in northwestern French Guiana near Saint-Laurent-du-Maroni in 2017 during a study of the impact of agriculture on aquatic insect communities. A second species of the same genus was collected in southeastern Peru from the Department of Madre de Dios, north of Puerto Maldonado, during an aquatic survey in August 2022, and additional specimens, including larvae, were collected there in 2023 and 2024. This paper will serve to describe, diagnose, and illustrate the adults and larva of the new taxa.

Materials and Methods

Institutional Depositories.

EMEC Essig Museum of Entomology, University of California, Berkeley, CA, USA
MNHN Muséum National d'Histoire Naturelle, Paris, France
MUSM Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru
MZSP Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil
USNM National Museum of Natural History, Washington, DC, USA

Aquatic Sampling. Peru. Sampling consisting of 13 collecting events was conducted over three years (2022–2024), during the months of July through October, along a short section of a stream (Quebrada Aguajal). During fieldwork in 2022 and 2023 by CBB, ZEA, and W. D. Shepard (University of California, Berkeley), only a few beetle specimens were handpicked from aquatic nets used to strain root masses, leaf litter, and woody debris from the stream. Collected specimens were immediately preserved in 95% ethanol for later examination in the lab. In 2024, CBB and W. D. Shepard returned to the site in an effort to obtain more specimens for the study, particularly males which had not been collected previously. To maximize success in finding the minute beetles, stream debris was collected in an aquatic net of fine-mesh Nitex® and spread on sheets of sheer fabric (white window curtain panels) on the ground. This technique facilitates drying of the debris, which encourages beetles to move that might otherwise remain immobile, enabling them to be seen more easily. In addition, two bulk samples of concentrated, fine debris were preserved with 95% ethanol at the site to be sorted through later under magnification in the lab. Geographic location and elevation were taken at the collection sites using a variety of hand-held devices.
French Guiana. The single French Guiana specimen was collected by AC in a bulk sample using a standard surber-net protocol. The sample was preserved in alcohol and later sorted in the lab under a binocular microscope. Water quality testing at the site was conducted with a WTW Multi 3410 digital pH/dissolved oxygen/conductivity meter and a Thermo Scientific™ Eutech TN-100 Turbidimeter.

Laboratory Procedures. Bulk samples preserved in the field were sorted by W. D. Shepard in the laboratory using an American Optical Spencer stereomicroscope. Specimens of the new taxa were examined and measured by CBB with the aid of a Leica MZ 125 stereomicroscope fitted with an ocular micrometer. Measurements of total body length include only the pronotum and elytra (excluding the variable space between); the length of the head is excluded. Measurements of total body width include both elytra at the widest point.

Twenty-eight adult specimens of *Nanelmis aguaje* Barr, **new species** and one of *Nanelmis longicruris* Barr, **new species** were dry mounted on card points and provided with permanent data labels in preparation for deposition in museum collections. Dissected genitalia were each placed in a genitalia vial with a drop of glycerin and pinned below the specimen. The genitalia of the male *N. longicruris* and of a selected female *N. aguaje* were imaged; the ovipositors of nine additional female *N. aguaje* were also dissected and examined, and many others were already extruded and available for examination without dissection. The mouthparts of adult and larval *N. aguaje* specimens were dissected, described, and imaged. Three adult and eight larval specimens were stored in vials with 95% ethanol; two disarticulated adults and one disarticulated larva were stored in glycerin, with small structures mounted on glass microscope slides.

Dytiscidae (Coleoptera) associated with *N. longicruris* in French Guiana were identified by D. L. Post (California Dept. of Fish and Wildlife).

Specimen Label Data. Label data are cited verbatim in the specimens examined sections. A forward slash "/" separates lines on a single label and a double forward slash "//" separates different labels. Clarifying information not appearing on the label is enclosed within brackets "[ ]".

Specimen Imaging. Habitus images were taken with a Visionary Digital BK Plus Lab System fitted with a Canon EOS 7D camera and Helicon Focus stacking software. Imaging of genitalia and mouthparts was done with a Keyence VHX-7000 digital microscope system. An Olympus TG-6 digital camera was used to take the habitat images. The various images were edited and assembled into plates using Adobe PhotoShop Elements®.

Study Material. Thirty-three adult and nine larval specimens from Peru, and one specimen from French Guiana, were included in this study. The specimens from Peru will be deposited in the EMEC, MUSM, MZSP, and the USNM, and that from French Guiana will go to the MNHN. Our fieldwork in Peru was authorized by the Servicio Nacional Forestal y de Fauna Silvestre (SERFOR) underRDGNo.D000443-2021-MIDAGRI-SERFOR-DGGSPFFS, and exported under export permit no. 003737-SERFOR.

Taxonomy

Nanelmis Barr, new genus

zoobank.org/urn:lsid:zoobank.org:act:BC78D8B0-1B61-4C7D-B030-3F04EA214EE8

(Figs. 1–11)

Type Species. *Nanelmis aguaje* Barr, **new species**.

Generic Diagnosis. Very small (1.5–2.0 mm long, excluding the head); very convex, smooth, shiny, without maculae or vittae; plastron restricted to venter except for genae; head with gula absent, gular sutures fused at midline; antenna long, extending past pronotal base; pronotum with complete sublateral carinae, without impressions or protuberances; elytra without sublateral carinae, elytral suture fused; elytral epipleuron wide, without punctures or granules; tibial cleaning fringes 1-1-1; tarsal claws simple.

Generic Description. Body (Figs. 1–3, 8) uniformly brown, teardrop shaped, very convex; 2× as long as wide, 1.7–2.0 mm long (excluding head), 0.8–1.0 mm wide ($n = 18$); dorsum shiny, very finely setose; plastron setae present on genae, nearly all ventral surfaces (except for along the midline of the prosternum, mesoventrite, and metaventrite), and on legs except for tarsi. **Head** without a gula, gular sutures fused at midline. Antenna filiform with 11 antennomeres; very long, extending past pronotal base. Mouthparts prominent, hypognathous; frontoclypeal suture distinct; clypeus wider than labrum; labrum convex, much longer than clypeus, apical margin distinctly emarginate, apical half densely covered with long setae; mandible large, at base nearly half width of labrum; maxilla with palpomere 4 elongate, about as long as palpomeres 1–3 combined, slightly curved mesad; labium with palpomere 3 ovoid and slightly curved mesad. **Pronotum** convex; shiny, with short, fine setae and small to moderately large punctures; smooth, without sculpturing except for 2 distinct, arcuate, sublateral carinae extending from base to apex. Anterior angles depressed, small, lobe-like, closely appressed to head. **Elytron** very convex; shiny, with short, fine setae; without carinae or sculpturing. Punctures moderately large, arranged in longitudinal rows. Elytral suture fused except for a small apical separation, weakly carinate posteriorly. Apex produced, abruptly narrowed at elytral apical one-fifth, depressed, deflected ventrally. Epipleuron very wide, extending to elytral apex, without granules or punctures. **Venter** lacking obvious punctures and granules; setae very sparse. Prosternal process narrowly to broadly subtriangular, with thickened, granulate, raised margins that extend anteriorly as two carinae nearly to anterior prosternal margin. Metaventrite with two longitudinal carinae. Abdominal ventrite 1 between metacoxae semicircular with raised margin; ventrite 5 generally triangular, longer than ventrites 1–4 combined. **Legs** long in comparison to body; nearly as long as, or longer than, body length. Procoxae and mesocoxae globular, metacoxae transverse. All tibiae with one cleaning fringe on each; protibia with fringe at apical two-thirds of anterior surface, mesotibia with fringe at apical two-thirds of posterior surface, metatibia with fringe at apical half of posterior surface. Tarsi each with 1 long, erect seta between claws; claws simple.

Larva. The larva of *Nanelmis* is known from *N. aguaje*, from Peru (Figs. 6, 7). It does not resemble any of the unassociated larvae described from French Guiana by Shepard *et al*. (2020). A description of the larva and comparative notes are provided within the *N. aguaje* treatment.

Larval Diagnosis (based on *N. aguaje*; Figs. 6, 7). Body elongate, subcylindrical, dorsal surface with coarse cuticular granules; head without frontal teeth; antennomere 2 without a long sensory appendage; thorax and abdominal segment I without lateral expansions; prothorax ventrally with 4 sclerites; procoxal cavities closed posteriorly; mesothorax with 2 protuberant dorsolateral spiracles at anterior one-third, each encircled by a larger, darkly pigmented area; abdominal segment I with pleural sclerites, remainder without; abdominal segment IX not unusually elongate, without a dorsal carina, apex deeply emarginate and sharply acute.

Etymology. The prefix "*Nan-*" is from the Latin *nanus*, meaning "a dwarf", to emphasize the very small size of members of this genus. The suffix "*-elmis*", from the genus *Elmis* Latreille, is a frequently used stem for genera in the family Elmidae.

Distribution. Neotropical South America. *Nanelmis* occurs in French Guiana and Peru and has recently been reported from Colombia (M. González-Córdoba, *in litt*.).

Habitat. The two small streams where *Nanelmis* specimens were collected are situated in the Amazon Biome in topographically flat, lowland areas with elevations of less than 300 m. Both flow through narrow riparian corridors surrounded by cleared agricultural or pasture land.

Remark. The metathoracic wings are brachypterous in adult *N. aguaje* (Figs. 2, 3b) and are present but of unknown configuration in *N. longicruris*. The elytra are fused in both species.

Comparative Notes. The lack of elytral carinae distinguishes *Nanelmis* from other genera with tiny species—such as *Austrolimnius* Carter and Zeck, *Gyrelmis* Hinton, *Jolyelmis* Spangler and Faitoute, *Neolimnius* Hinton, *Notelmis* Hinton, *Onychelmis* Hinton, *Oolimnius* Hinton, *Pilielmis* Hinton, *Tolmerelmis* Hinton, *Tyletelmis* Hinton, *Xenelmis* Hinton, and *Zunielmis* González-Córdoba and Manzo—all of which have elytral carinae. An unusual character shared with *Notelmis* is that the gular sutures of the ventral head are fused at the midline (Hinton 1941). *Nanelmis* has been placed as a sister group to *Gyrelmis* and *Austrolimnius* in a currently unpublished phylogeny (M. González-Córdoba, *in litt*.). In Table 1, *Nanelmis* is compared with nine other elmid genera on the basis of presence or absence of 15 distinguishing characters (partially adapted from Table 1 in González-Córdoba *et al.* 2021).

Because of its small size, *Nanelmis* keys to couplet 17 in Manzo (2005) along with *Xenelmis* and *Oolimnius*. With the following modifications to that key, it may be inserted as follows:

17. Body length more than 2 mm. Pronotum not tomentose, with nearly complete sublateral carinae. Elytra with sublateral carinae composed of low rows of granules ..... ***Oolimnius***
— Body length less than 2 mm. Pronotum and elytra variable 17.5
17.5. Pronotum tomentose, usually without sublateral carinae (only in the *X. granata* group). Elytra with sublateral carinae ..... ***Xenelmis***
— Pronotum nearly glabrous, with complete sublateral carinae. Elytra without sublateral carinae ..... ***Nanelmis*, new genus**

Nanelmis aguaje Barr, new species

zoobank.org/urn:lsid:zoobank.org:act:B83C2C57-CCBC-4D65-B925-29B01EBEDA43

(Figs. 1–7, 10)

Type Locality. Quebrada Aguajal (Fig. 10) at Finca Las Piedras field station; −12.2270°, −69.1172°, elevation ca. 250 m.; Monterrey, *ca.* 48 km north of Puerto Maldonado, Las Piedras District, Tambopata Province, Madre de Dios Department, Peru.

Diagnosis. Frons smooth, not granulate; pronotum wider at middle than at base, lateral margins evenly arcuate, disc with moderately large, deep punctures; prosternal process weakly convex medially; metaleg approximately the same length as body; protibia with cleaning fringe nearly half the tibial length.

Description. Holotype ♀. Body (Figs. 1, 2) entirely medium brown, shiny; convex, hump-backed; 2× as long as wide; length 1.81 mm (excluding head), width 0.91 mm. **Head** color slightly lighter than pronotum; frons shiny medially where

Table 1. Distinguishing characteristics of *Nanelmis*, **new genus**, in comparison with other small Neotropical genera of Elmidae; x = character present, s = character present in some species. Format of table taken from González-Córdoba *et al.* (2021).

Character	*Nanelmis*	*Austrolimnius*	*Gyrelmis*	*Jolyelmis*	*Neolimnius*	*Notelmis*	*Oolimnius*	*Tolmerelmis*	*Xenelmis*	*Zunielmis*
Dorsal plastron					x		x	x	x	x
Cuticle with light/dark color patterns			s		x			x	s	x
Cuticle with pearly iridescence					x		x	x	s	x
Frons carinate					x		x	x	x	x
Gena lacking plastron					x		x	x	x	x
Gula absent, gular sutures fused	x					x				
Body margins crenulate					x		x	x		x
Pronotum with sublateral carinae	x	x	x	x	x		x	x	s	x
Elytra with carinae		x	x	x	x	x	x	x	x	x
Prosternal process expanded over procoxae	x	x	x	x			x	x	x	x
Mesoventrite expanded over mesocoxae		x	x			x	x	x	x	x
Metaventrite with carinae	x	x	x	x				x		
Abdominal ventrite 1 with carinae	x		x	x				x	s	
Mesotibia with tufts of long setae								x		x
Tibial cleaning fringes absent					x					x

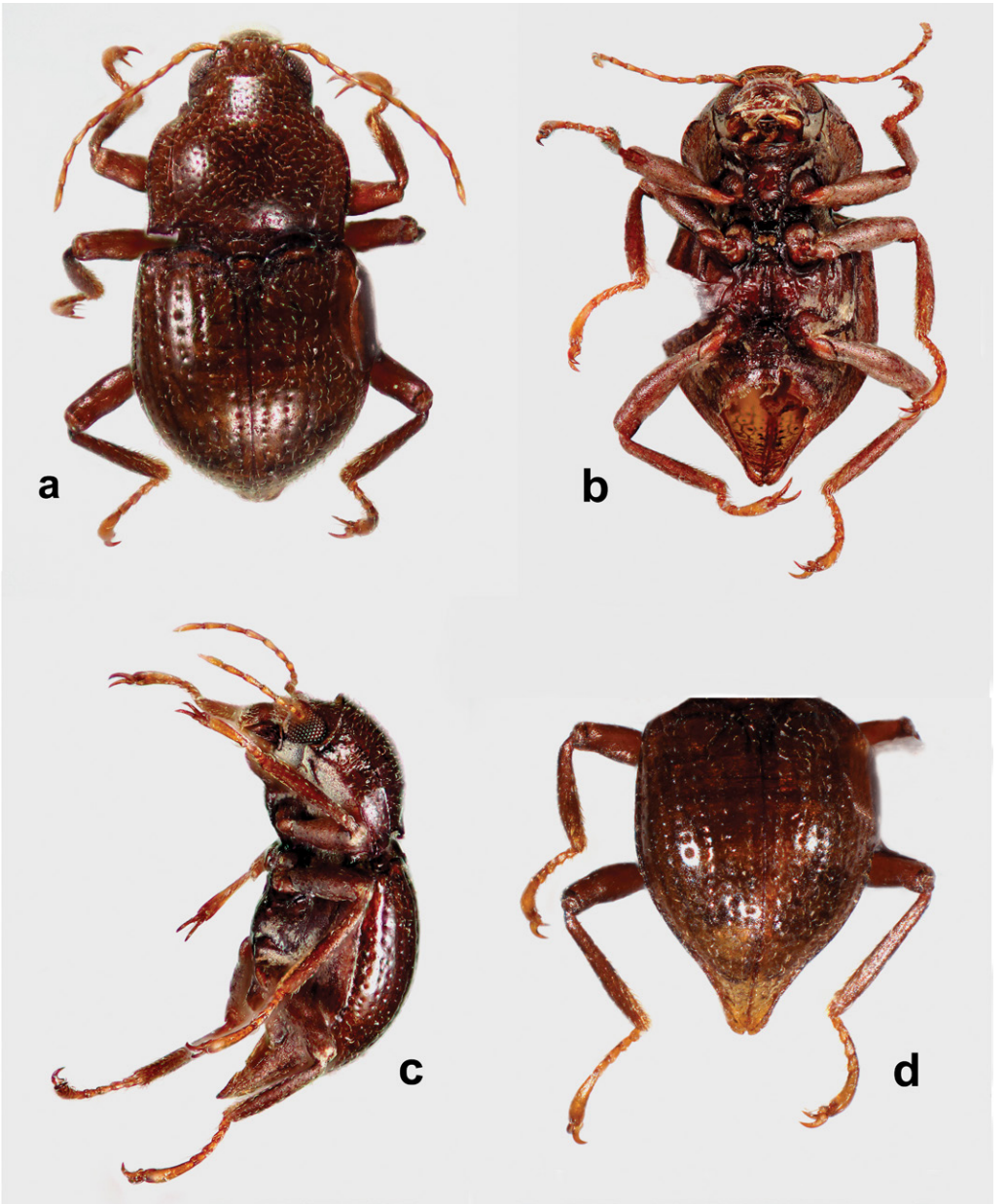
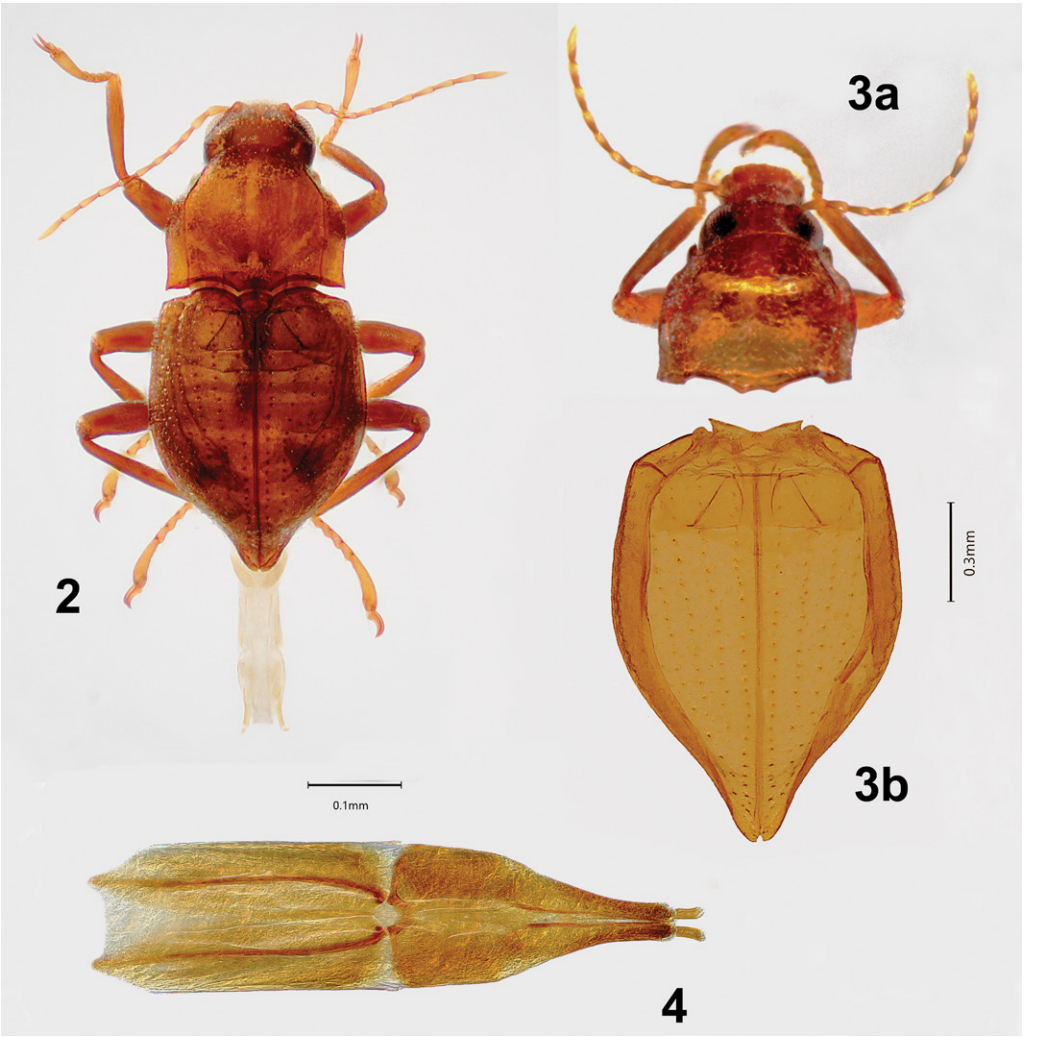


Fig. 1. *Nanelmis aguaje*, **new species**, adult female; length 1.8 mm (excluding head). a) Dorsal habitus, b) Ventral habitus, c) Lateral habitus, d) Elytra, tilted to show produced apices.

glabrous, elsewhere sparsely covered with moderately long, yellow setae; frons with anterolateral margins sharply raised to cover antennal bases, with a shallow depression posterior to each base; frontoclypeal suture deeply incised; gena covered with plastron setae, with a semicircular emargination adjacent to mandible base. *Antenna* filiform, with 11 antennomeres; very long, much longer than pronotal length. Antennomeres 1 and 2 stouter than the rest; antennomeres 3–10 similarly shaped, longer than wide, widest at apex; antennomere 11 narrowly fusiform. Antennal bases separated by more than the length of antennomeres 1–3. *Eye* slightly protuberant, subcircular, diameter less than interocular



Figs. 2–4. *Nanelmis aguaje*, **new species**, adult female. **2)** Dorsal habitus, wet specimen, brachypterous wings visible beneath elytra; length 1.8 mm (excluding head); **3)** Disarticulated specimen: a) Head and pronotum, b) Elytra, fused, ventral view; **4)** Ovipositor, dorsal view.

distance. *Clypeus* convex, rectangular, about 4× wider than long; apical margin weakly arcuate; sparsely setose. *Labrum* (Fig. 5a) convex, subrectangular, about 2× wider than long, at least 2× longer than clypeus; basal one-third glabrous, apical two-thirds densely covered with long, yellow setae; apical margin weakly emarginate, apicolateral margins broadly rounded. *Mandible* (Fig. 5b) subquadrate; apex with large, mesally curved lobe bearing 2 small, closely spaced teeth at the tip; outer margin at base of lobe with a prominent notch; prostheca membranous, almost one-fourth width of mandible; mola thick, well-sclerotized. *Maxilla* (Fig. 5c) with 4 palpomeres; palpomere 1 very short, narrow; palpomere 2 much longer, apically wider than palpomere 1, about 2× longer than palpomere 3 and wider; palpomere 4 elongate, slightly curved mesad, longer than 1–3 combined and wider, apex with circular sensory patch. Galea elongate, extending past lacinia, as long as palpomeres 2+3 and narrower; apex with long setae about one-third as long as galea. Lacinia broadly sickle-shaped, margined with long, thick setae. *Labium* with 3 palpomeres; palpomere 1 cylindrical, narrow, nearly as long as palpomere 3; palpomere 2 shorter, wider; palpomere 3 ovoid, slightly curved mesad, about 2× as long as palpomere 2 and as wide, apex with a circular sensory patch. **Pronotum** (Figs. 1a, 2, 3a) irregularly

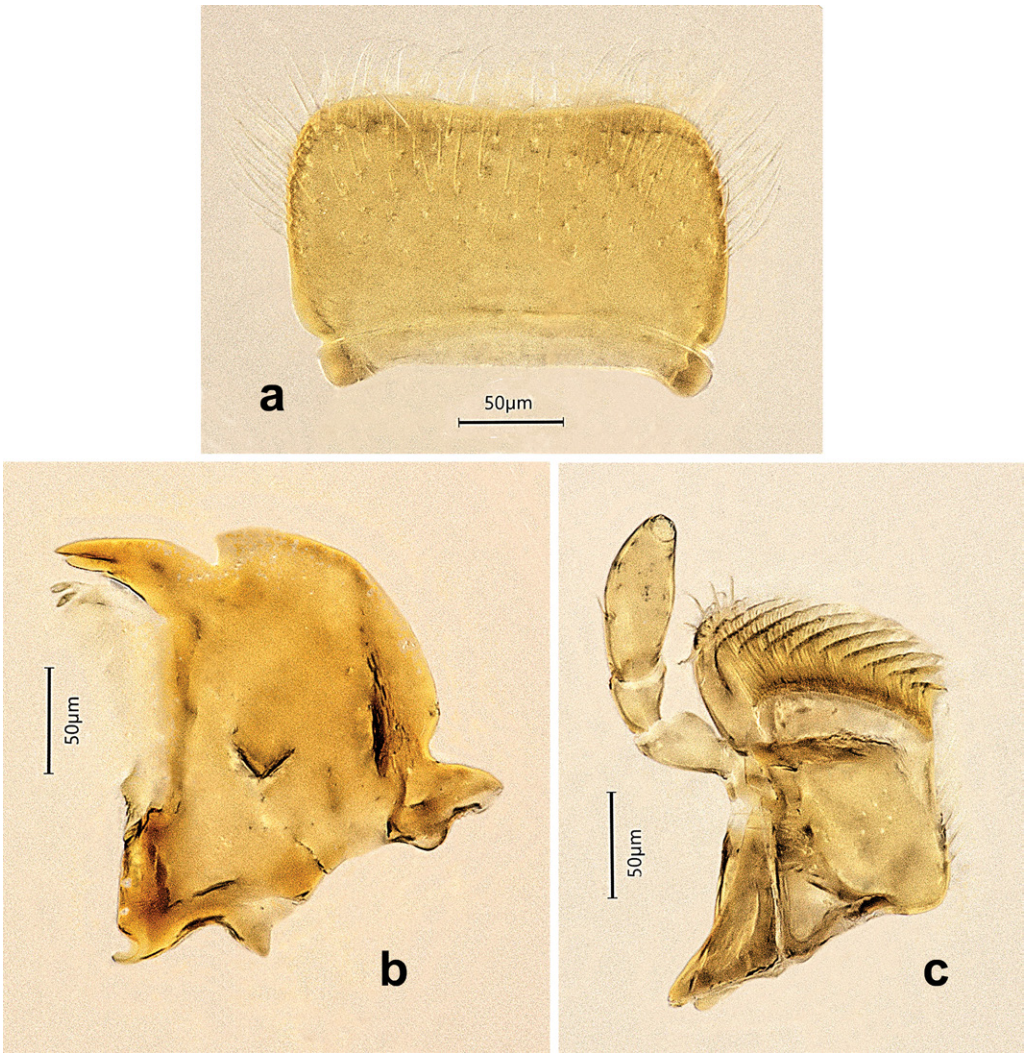


Fig. 5. *Nanelmis aguaje*, **new species**, adult female, mouthparts. a) Labrum, b) Mandible, c) Maxilla.

hexagonal; wider than long, 0.75 mm wide, 0.61 mm long; widest at middle; base about 1.4× wider than apex. Convex, with 2 complete, arcuate sublateral carinae extending from base to apex; without sulci, depressions, or protuberances; disc with moderately large, deep punctures spaced about 1 puncture apart and moderately sparse, short, curved, pale-yellow setae. Anterior margin strongly arcuate medially, sinuate and margined laterally; anterior angles short, depressed, acute, closely appressed to head. Lateral edges evenly arcuate, thickly marginate. Posterior margin on each side straight between lateral margin and sublateral carina, trisinuate medially; posterior angles acute. Hypomeron covered with dense plastron setae; anterior angles each a small, flat, angular lobe. **Scutellar shield** triangular with curved anterior margin; glabrous. **Elytron** (Figs. 1, 2, 3b) 1.20 mm long, 0.45 mm wide; teardrop-shaped (especially when viewed conjointly), with apex produced. Lateral edge narrowly margined; straight at basal half; arcuate to apical one-sixth, where abruptly constricted; apical one-sixth very produced. Dorsal surface very convex at basal four-fifths, depressed and angled ventrally at apical one-fifth to one-sixth; without lateral carinae or sculpturing; setae sparse, pale yellow, curved. Elytral suture fused except for a small separation at the apex (Fig. 3b); suture weakly carinate at apical one-fifth. Disc with 8 rows of large, moderately deep punctures mostly spaced less than 1 diameter

apart: rows 1, 2, 3, 4, 6, and 8 begin near the basal margin; row 5 begins about one-third elytral length from base; row 6 begins in a shallow sulcus adjacent to humeral angle, with basal punctures larger, more closely spaced; row 7 begins about one-sixth elytral length from base; row 8 lies closely adjacent to lateral edge. Intervals flat. Humerus weakly raised, not prominent; broadly rounded. Epipleuron very wide, flat, band-like, tapering from metaventrite to an acute apex; covered with dense plastron setae. **Metathoracic wings** brachypterous (Fig. 2) (Shepard 2019). **Prosternum** (Fig. 1b) long, about as long as metaventrite, length anterior to procoxae subequal to length of prosternal process; disc sparsely setose; chin piece weakly convex and declivous at sulcus basal to prosternal process, apical margin strongly arcuate. Prosternal process narrowly triangular; margins thick, reflexed, irregular, granulate; weakly convex medially, glabrous, shiny; apex broadly rounded. **Mesoventrite** (Fig. 1b) very short; disc completely covered with plastron setae laterally between meso- and metacoxae; mesoventral cavity deep, thickly margined. **Metaventrite** (Fig. 1b) long, about as long as prosternum. Disc convex, laterally bounded by longitudinal carinae; discrimen complete, becoming wider, deeper posteriorly. Disc surface shiny, nearly glabrous medially, completely covered with plastron setae laterally. Metaventral process truncate, thickly margined anteriorly, shallowly concave. **Legs** (Figs. 1, 2) long in relation to body; metaleg longest, about as long as body length; proleg shortest. Coxae covered with plastron setae; pro- and mesocoxae globular, metacoxae transverse. Femora of all legs covered with plastron setae; profemur with a dense, golden-yellow patch of moderately long, very fine, recumbent setae on the mesal anterior surface; mesofemur with a similar patch on the posterior surface; metafemur with none; other femoral surfaces with sparse, semierect setae. Tibiae of all legs covered with plastron setae, each with a cleaning fringe; protibia with a thin, golden-yellow, apical cleaning fringe nearly two-thirds tibial length on the anterior surface; mesotibia with a thin, barely visible apical fringe about two-thirds tibial length on the posterior surface; metatibia with a thin, apical fringe about half tibial length on the posterior surface; remaining tibial surfaces with long, moderately dense, semierect setae. Tarsi of all legs bearing sparse, scattered, long and a few very long, setae; tarsomeres 1–4 of each with dense ventral clusters of stiff setae at posterior margins; tarsomere 5 longer than 1–4 combined, bearing a fine apical seta between and as long as claws; claws simple, short, moderately stout, acute, darker at tips than bases. **Abdomen** (Fig. 1b) about one-third longer than metaventrite; convex, especially at midline. Surface covered with plastron setae and short, recumbent, yellow setae; ventrites 1–4 each with a fringe of short setae at the posterior margin. Abdominal ventrite 1 between metacoxae with a raised, semicircular margin enclosing a concave, rugose area; ventrite 2 with several faint, longitudinal rows of low carinae near the middle; ventrites 1–3 shorter along midline than along lateral margins; ventrite 3 shortest; ventrite 4 as long as ventrite 2 medially; ventrite 5 nearly as long as 1–4 combined, subtriangular, anterior margin arcuate, apex narrowly rounded. **Ovipositor** (Fig. 4) more than 4× longer than wide, moderately sclerotized; paraproct about half as long as ovipositor, lateral margin straight, medial margin slightly arcuate, baculus distinct; proximal gonocoxite subrectangular, longer than wide, about two-thirds length of distal gonocoxite; distal gonocoxite narrowed apically, lateral margin curved inward, medial margin nearly straight; gonostylus digitate.

Male. Unknown. All of the 33 adult specimens are female, which is very surprising given what is known of the life history of Elminae.

Variation. Individuals in the female series vary slightly in size: length 1.70–1.97 mm, width 0.83–0.98 mm ($n = 17$). Cuticle color varies from yellow to red-brown or medium brown, sometimes with the pronotum slightly darker than the elytra. Six very pale-yellow specimens are assumed to be teneral. The elytral punctures appear more impressed and striate in darker individuals than paler ones. The amount and distribution of setae is variable on the head. On abdominal ventrite 2, the median, longitudinal rows of faint carinae are sometimes indistinct or are replaced by elongate granules.

Comparative Notes. *Nanelmis aguaje* (Fig. 1) may be distinguished from *N. longicruris* (Fig. 8) by the following (*N. aguaje* character state first, *N. longicruris* character state second): metaleg about the same length as body vs. distinctly longer than body; frons smooth, not granulate vs. frons granulate; pronotum with lateral sides evenly arcuate vs. lateral sides not evenly arcuate, with two pairs of slight angulations; pronotum wider at middle than base, punctures moderately large, deep vs. pronotum slightly wider at base than middle, punctures small, shallow; prosternal process weakly convex medially vs. impressed medially; cleaning fringe of protibia nearly half the tibial length vs. two-thirds the tibial length. Note: This comparison is based on 33 specimens of *N. aguaje* and only one specimen of *N. longicruris*.

Type Specimens. Holotype ♀, pinned, deposited in MUSM. **PERU.** "PERU: Madre de Díos / Monterrey, 48 km N / Puerto Maldonado / 20-VIII-2024, C.B. Barr / & W.D. Shepard collrs. // Finca las Piedras / Quebrada Aguajal / -12.2270°, -69.1172° / *Mauritia* palm swamp // [genitalia in vial below specimen] // HOLOTYPE / Nanelmis / aguaje Barr [red, handwritten label]". **Paratypes**

(27♀). **PERU.** "PERU: Madre de Díos /Monterrey, 48 km N / Puerto Maldonado / 20-VIII-2024, C.B.Barr & W.D. Shepard collrs. // Finca las Piedras / Quebrada Aguajal / -12.2270°, -69.1172° / *Mauritia* palm swamp" (10♀; 4 EMEC, 3 MUSM, 1 MZSP, 2 USNM); as previous, except "21-VIII-2024 // -12.2272°, -69.1171°" (2♀; 1 EMEC, 1 MUSM); as above, except "20 VIII 2024 250 m / S12°13.6127′ / W69°07.0324′ // [on reverse] WDS-A-2228" (8♀; 3 EMEC, 5 MUSM); as previous, except "21 VIII 2024 313m [elevation error] / S12°13.5220′ / W69°07.0946′ / [on reverse] WDS-A-2229" (2♀; 1 EMEC, 1 MUSM); "PERU: Madre de Díos /Monterrey, 48 km N / Puerto Maldonado / Finca las Piedras / 27-VII-2022, C.B. Barr // Quebrada Aguajal / -12.2270°, -69.1172° / *Mauritia* palm swamp" (1♀ EMEC); "PERU: Madre de Díos / Finca Las Piedras / 28 VII 2022 / Aguaje palm swamp / -12.2255° -69.1184° // William D. / Shepard, leg. / [on reverse] WDS-A-2164" (1♀ EMEC); as previous, except "25-VIII-2022, collr. / Z. Escalante Arteaga // -12.2261°, -69.1186° [2022-P2]" (1♀ MUSM); as previous, except "30-VIII-2022 [2022-P2]" (1♀ MUSM); as previous, except "X-2023, // -12.2259°, -69.1183° [2023-P4]" (1♀ MUSM). Paratypes all with the following label: "PARATYPE / *Nanelmis* / *aguaje* Barr [yellow label, printed]".

Other Specimens Examined (5♀). **PERU.** "PERU: Madre de Díos /Monterrey, 48 km N / Puerto Maldonado / 20-VIII-2024, C.B.Barr & W.D. Shepard collrs. // Finca las Piedras / Quebrada Aguajal / -12.2270°, -69.1172° / *Mauritia* palm swamp" (4♀ EMEC; 3 in 95% ethanol, 1 disarticulated, in glycerin); "PERU: Madre de Díos / Finca Las Piedras / 20 VIII 2024 250 m / Aguaje palm swamp / S12°13.6127′ / W69°07.0324′ // William D. / Shepard, leg. / [on reverse] WDS-A-2228" (1♀ EMEC; disarticulated, in glycerin).

Larval Diagnosis. Same as for the genus, given above.

Larval Description (Figs. 6, 7). Last instar. Body elongate, tapered, semicircular in cross section, ventrally flattened; moderately sclerotized; color yellow to yellow-brown; surface moderately granulate with sparse, long, pale, erect setae; body length approximately 3.5–3.7 mm (excluding head) and width 0.6 mm (n = 8). **Head** (Fig. 7) partially retracted into prothorax, subcircular in frontal view; frons flat, sparsely setose, with V-shaped frontal suture; frontal teeth absent. *Antenna* with 3 antennomeres, inserted laterad of mandible; antennomere 2 longer than antennomeres 1+3; antennomere 2 without a long sensory appendage. *Stemmata* in a tight, oval cluster; individual stemma not discernible. *Clypeus* transverse. *Labrum* transverse, longer than clypeus, translucent, convex, margined with setae, lateral margins broadly rounded, apex distinctly emarginate. *Mandible* (Fig. 7c) subtriangular, apex blunt, inner margin slightly irregular. *Maxilla* (Fig. 7b) with a short, 3-segmented palpus. **Thorax** dorsum covered with small, evenly spaced, setiferous granules separated by about 1–2× their diameters and sparse, short to long, erect, pale setae; lateral margins coarsely crenulate. Prothorax nearly as long as combined lengths of meso- and metathorax, which are subequal in length; dorsal anterior one-third shallowly depressed; venter with 4 sclerites (two anterolateral, one between coxae, one posteromedial), forming a posterior sternum such that procoxal cavities are closed posteriorly. Meso- and metathorax anterior to coxae each with a marginal row of small, sharp teeth; a similarly serrate, transverse row present from anterior coxal margin to anterolateral margin of sternum; junction of the 2 rows elevated and very serrate. Mesothorax with 2 protuberant dorsolateral spiracles (indicative of last instar larva) at anterior one-third, each encircled by a larger, darkly pigmented area. Meso- and metacoxal cavities open posteriorly. **Legs** of similar size; stout; covered with numerous, moderately long, pale, erect setae. Tarsungulus stout. **Abdomen** semicircular in cross-section; dorsum covered with low, widely spaced granules and scattered, sparse, long, semierect setae. Segments I–VIII decreasing slightly in length posteriorly; each segment with 2 dorsolateral spiracles encircled by a larger, darkly pigmented area; spiracles of segment II protuberant. Venter of each segment with lateral clusters of fine, erect, curved setae; posterior margin of each with a fringe of moderately long, recumbent setae. Pleural sclerites present on segment I, absent on segments II–IX. Segment I with lateral margins carinate, coarsely crenulate; segment II with a line of granules along lateral margin. Segments I–V each with a pair of teeth at posterolateral margins; teeth of segment I large, spinose; teeth of succeeding segments progressively smaller; teeth of segments IV and V small, tuberculate. Segment IX as long as segments IV–VIII combined; slightly darker in color than rest of body; dorsum not longitudinally carinate; dorsum with numerous, moderately long, semierect setae; apex deeply emarginate, with 2 long, narrow, very acute lateral spines tipped with long, fine setae. Ventral operculum as long as segment IX excluding lateral spines, narrowly triangular with rounded angles; operculum covering retractile, tracheal anal gills and a pair of long, thin, translucent, acute opercular claws.

Larval Comparative Notes. The larva of *N. aguaje* (Figs. 6, 7) is most similar to that of *Gyrelmis* (González-Córdoba, *in litt*.), with which it shares many characters, including: pleurites on only the first abdominal segment; prothorax ventrally with four sclerites; procoxal cavities closed posteriorly; head without frontal teeth; and antennomere 2

Fig. 6. *Nanelmis aguaje*, **new species**, larva, last instar; length approximately 3.5–3.7 mm. a) Dorsal habitus, b) Lateral habitus, c) Ventral habitus.

without a long sensory appendage. *Nanelmis aguaje* larvae can be distinguished from *Gyrelmis* larvae by the body form being subcylindrical and elongate rather than humpbacked and conical; the presence of dorsal cuticular granules; the thorax and abdominal segment I without lateral expansions; and the last abdominal segment deeply forked. The undescribed larva of *Gyrelmis* is currently in the process of being formally described (M. González-Córdoba, *in litt.*).

Notelmis and *Onychelmis* larvae are likewise undescribed but have been associated with adults. *Nanelmis* is similar in many respects but may be distinguished from both genera by abdominal segment IX which is deeply emarginate and acute at the apex and not dorsally carinate (M. González-Córdoba, *in litt.*).

Xenelmis larvae differ from *Nanelmis* larvae in having a conical, hump-backed, curved shape; procoxal cavities open posteriorly; and pleural sclerites on abdominal segments I–VI (Manzo and Archangelsky 2008; Shepard *et al*. 2020).

Austrolimnius differs in having antennomere 2 with a sensory appendage as long as the antennomere; pleural sclerites on abdominal segments I–VII; and abdominal segment IX very elongate, 2.5× as long as wide (Manzo and Archangelsky 2008; Shepard *et al*. 2020).

Larval Specimens Examined (9). **PERU.** "PERU: Madre de Díos / Finca Las Piedras / 20 VIII

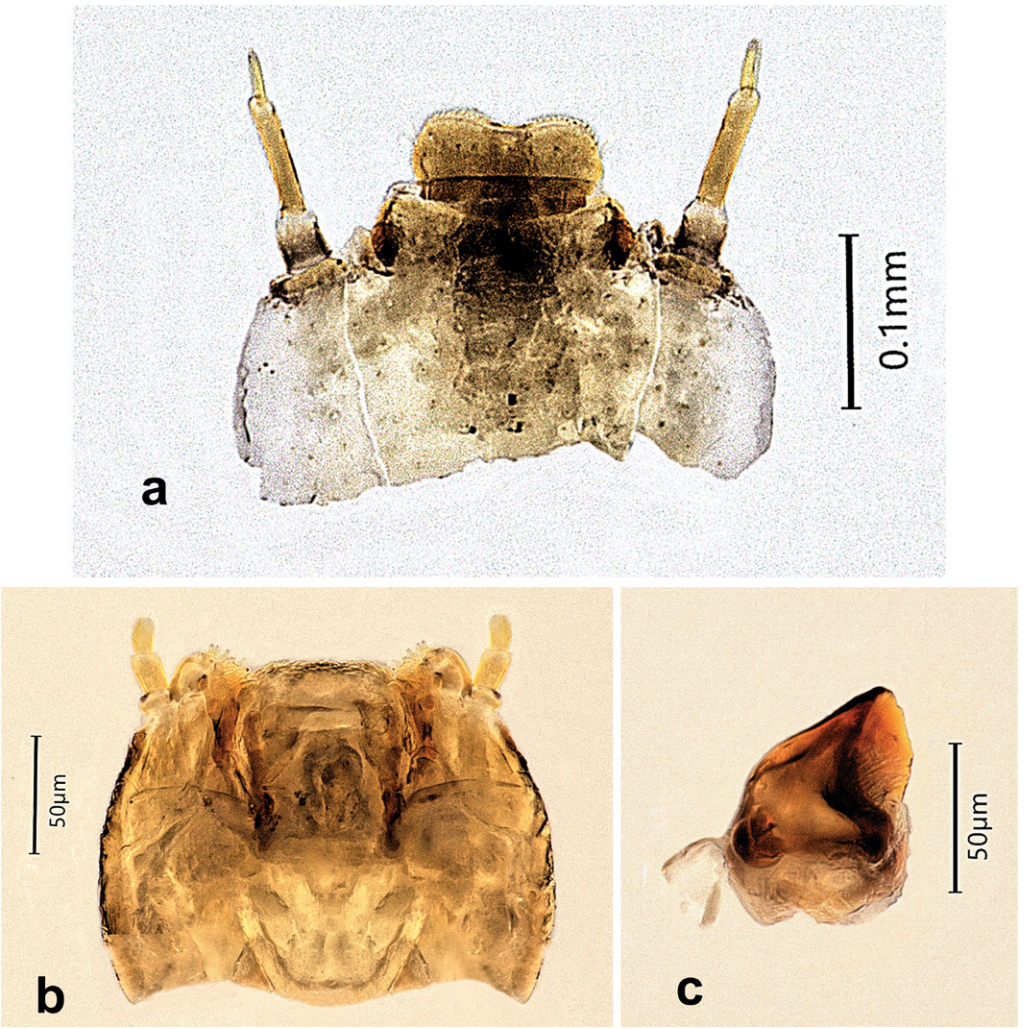


Fig. 7. *Nanelmis aguaje*, **new species**, larva, head and mouthparts. a) Head, dorsal view, b), Maxillolabial complex, internal view, c) Mandible.

2024 250 m / S12°13.6127′ / W69°07.0324′ // [on reverse] WDS-A-2228 (6 EMEC, 5 in ethanol, 1 in glycerin, disarticulated); as above, except 21 VIII 2024 / S12°13.5220′ / W69°07.00946′ / [on reverse] WDS-A-2229" (3 EMEC, in ethanol).

Larval Remarks. Nine larvae associated with adult specimens are assumed to be the same species as the adults with which they were collected. The only other elmid collected during extensive sampling at the type locality was *Heterelmis* Sharp, the larva of which is known and does not resemble that of *N. aguaje*. Last larval instars were used in formulating the composite description.

Etymology. The specific epithet, *aguaje*, a noun in apposition, is a Peruvian name in Spanish for the *Mauritia flexuosa* L. f. (Arecaceae) palm trees that grow along Quebrada Aguajal, the swampy stream where the species was collected.

Distribution. *Nanelmis aguaje* is known only from the type locality in southeastern Peru, approximately 48 km north of Puerto Maldonado and approximately 30 km west of the Bolivian border.

Habitat and Temporal Occurrence. Quebrada Aguajal (Fig. 10) is a very small tributary of Quebrada Planchon which joins the Río Manuripi in Bolivia and ultimately drains into the Amazon River. Quebrada Aguajal is fed by springs and groundwater discharge and originates about 1.0–1.5 km northwest of the sampling sites at Finca

Las Piedras (G. Gallice, *in litt.*). On the Finca Las Piedras property, the stream flows through a heavily shaded aguaje palm (*M. flexuosa*) swamp (called an "aguajal" in Peru) adjacent to forested areas and deforested areas of open fields at an elevation of approximately 250 m. The vegetation beyond the riparian zone has been almost entirely cleared upstream and partially cleared downstream of the sampling area. At the collection sites, the stream width was less than 2 m and varied in depth from as shallow as 8 cm to at nearly 1 m deep in pools. The substrate was composed of silt, sand, and forest detritus, with occasional root masses from riparian vegetation. Fallen tree branches with accumulated leaf packets choked the narrow channel. The water flow during the dry season sampling period was slow in narrower stretches to nearly imperceptible where wider. The water was moderately clear when the substrate was undisturbed.

All the adult specimens were collected in July, August, and October, during the drier months of the year. All the larval specimens were found in bulk samples taken in August. Adult specimens were collected from root masses, leaf packs, and woody debris during four sampling events in July and August 2022, one event in October 2023, and three events in August 2024. Twenty-four of the 33 adult beetles (73%) were collected at one specific spot where roots from riparian vegetation were common in the stream. Root masses appear to be the favored microhabitat, although a few specimens were collected from leaf packs.

Associated Aquatic Insecta. Coleoptera: Elmidae: Elminae: *Heterelmis* sp.; Dryopidae: *Dryops* Olivier sp. Besides *N. aguaje*, the only other elmid present in Quebrada Aguajal was an unidentified species of *Heterelmis*. During sampling in 2022 and 2023, 367 adult specimens of *Heterelmis* sp. were collected in conjunction with just five specimens of *N. aguaje*. However, in August 2024, only one specimen of *Heterelmis* was collected along with 28 specimens of *Nanelmis*. This disparity could be due to our focus on root masses in 2024 rather than leaf packs which we originally thought to be the primary microhabitat.

Hemiptera: Heteroptera: see Sites (2023) for an extensive list, including description of a new species of Naucoridae from Quebrada Aguajal, *Maculambrysus gallicei* Sites. The aquatic insect fauna of Quebrada Aquajal is generally more indicative of lentic rather than lotic conditions.

Remark. We credit our improved collecting success in 2024 (n = 28), as opposed to previous collections in 2022 and 2023 (n = 5), to changes in sampling technique to better target the tiny beetles (see Material and Methods).

Nanelmis longicruris Barr, new species

zoobank.org/urn:lsid:zoobank.org:act:DB8AC1BB-254C-4A21-A324-C9D0DA9455B3

(Figs. 8, 9, 11)

Type Locality. Crique Chicot (Fig. 11); 05.5610°, −53.8315°, elevation *ca.* 20 m; *ca.* 5 km S Javouhey, *ca.* 23 km NE of Saint-Laurent-du-Maroni, French Guiana.

Diagnosis. Frons granulate; pronotum slightly wider at base than middle, lateral margins with 2 pairs of slight angulations, disc with small, shallow punctures; prosternal process impressed medially; metaleg distinctly longer than body; protibia with cleaning fringe nearly two-thirds the tibial length.

Description. Holotype ♂. Body (Fig. 8) entirely medium brown, shiny; convex, hump-backed, 2× as long as wide; length 1.66 mm (excluding head), width 0.80 mm. **Head** color slightly darker than pronotum; frons covered with scattered, large granules and moderately long, yellow setae; frons with anterior margin thickened between antennae, sharply raised to cover antennal bases, with a small depression posterior to each base; frontoclypeal suture deeply incised; gena covered with plastron setae, with a semicircular emargination adjacent to mandible base. *Antenna* filiform, with 11 antennomeres; very long, much longer than pronotal length. Antennomeres 1 and 2 stouter than the rest; antennomeres 3–10 similarly shaped, longer than wide, widest at apex; antennomere 11 narrowly fusiform. Antennal bases separated by about the length of antennomeres 1+2. *Eye* slightly protuberant, subcircular, diameter less than interocular distance. *Clypeus* weakly convex; subrectangular, about 3× wider than long; setose; apical margin moderately arcuate. *Labrum* very convex, subrectangular, nearly as long as wide, at least 2× longer than clypeus; basal half glabrous, apical half densely covered with long, yellow setae; apical margin distinctly emarginate, apicolateral margins broadly rounded. *Maxilla* with 4 palpomeres; palpomere 1 very short, narrow; palpomeres 2 and 3 stout, palpomere 2 longer and wider than 3, each about 2× wider than palpomere 1; palpomere 4 elongate, slightly curved mesad, longer than palpomeres 1–3 combined and wider, apex with a circular sensory patch. *Labium* with 3 palpomeres; palpomere 1 not visible; palpomere 2 short, narrow; palpomere 3 ovoid, slightly curved mesad, more than 2× as long and wide as palpomere 2, apex with a circular sensory patch. **Pronotum** (Fig. 8a) irregularly hexagonal; wider than long, 0.56 mm long, 0.75 mm wide; widest at base, base about 1.6× wider than apex. Convex, with 2 complete, laterally arcuate sublateral carinae extending from base to apex; without sulci, depressions, or protuberances; disc with small, fine punctures and

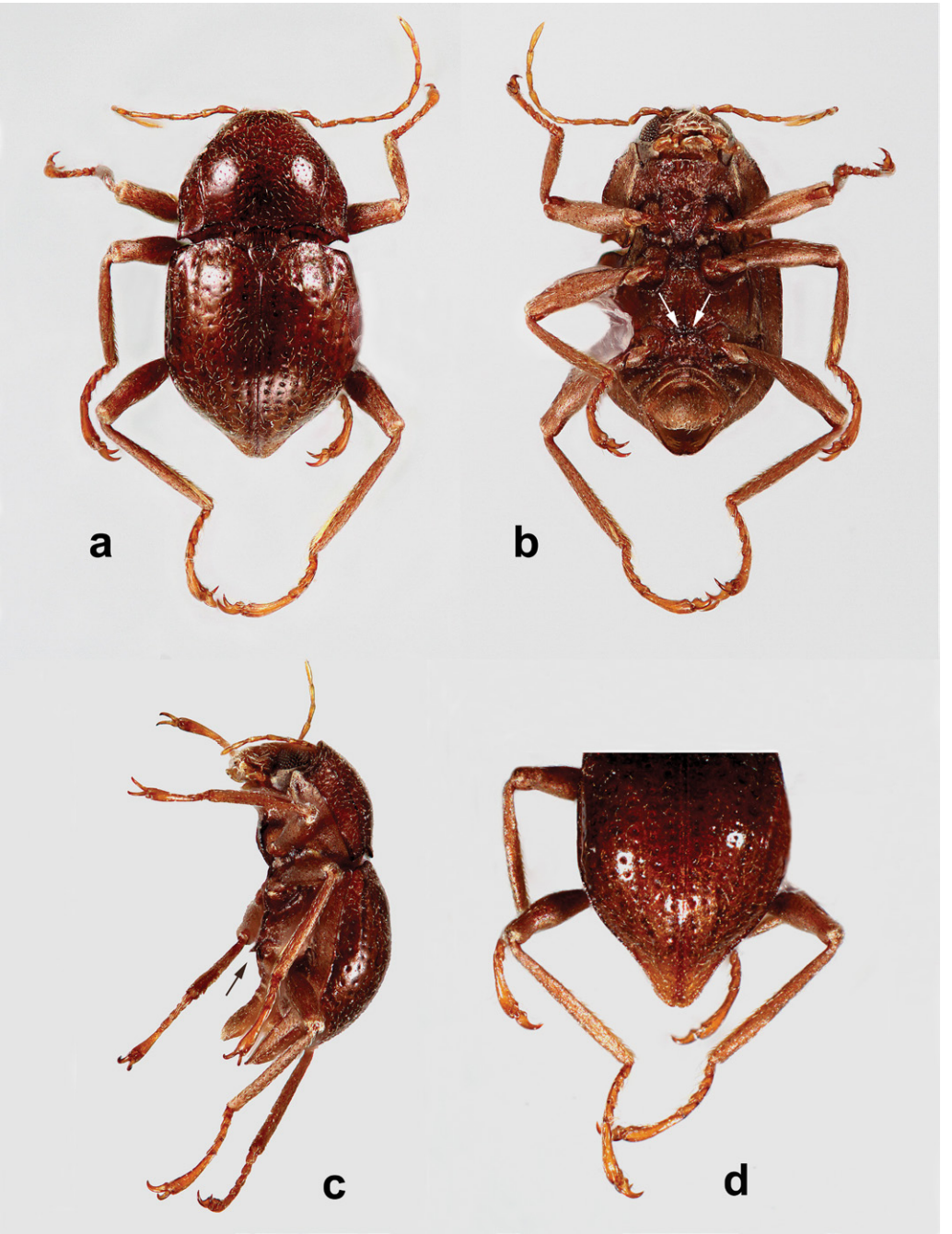


Fig. 8. *Nanelmis longicruris*, **new species**, holotype, adult male; length 1.7 mm (excluding head). a) Dorsal habitus, b) Ventral habitus, with arrows indicating position of metaventral teeth, c) Lateral habitus, with arrow indicating metaventral tooth, d) Elytra, tilted to show produced apices.

moderately sparse, short, curved, pale-yellow setae. Anterior margin arcuate; anterior angles short, depressed, blunt, closely appressed to head. Lateral edge thickly marginate; not evenly arcuate, with 2 low angulations, 1 just posterior to anterior angle and 1 at one-third distance from base. Posterior

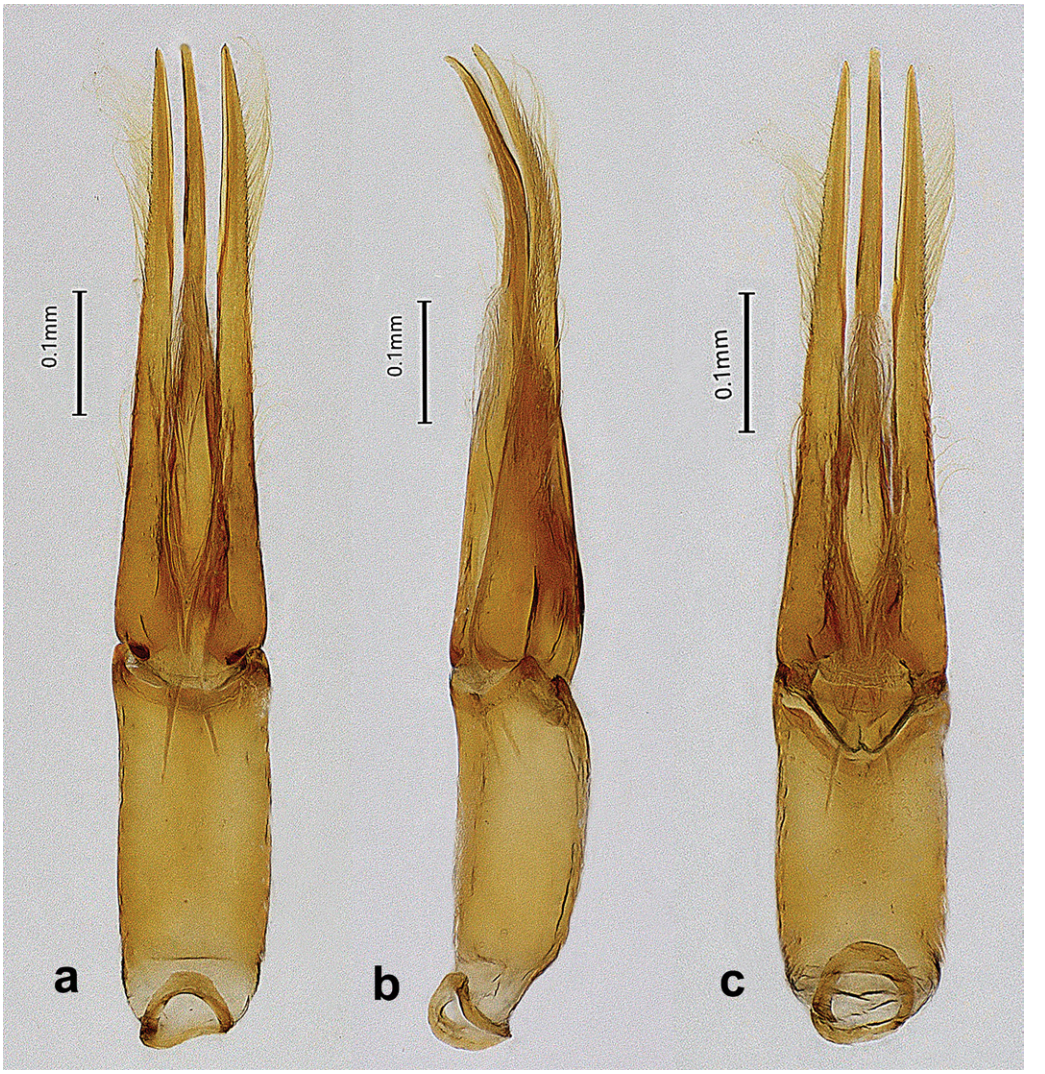


Fig. 9. *Nanelmis longicruris*, **new species**, holotype, aedeagus. a) Dorsal view, b) Lateral view, c) Ventral view.

margin on each side straight between lateral margin and sublateral carina, trisinuate medially; posterior angles acute. Hypomeron covered with dense plastron setae; anterior angles each a flat, protruding, rounded lobe. **Scutellar shield** triangular with curved anterior margin; glabrous. **Elytron** (Fig. 8) 1.10 mm long, 0.40 mm wide; teardrop-shaped (especially when viewed conjointly), constricted at apical one-fifth, with apex produced. Lateral margin narrowly margined; straight at basal half, then angled inward to a long, produced apex at apical one-fifth. Dorsal surface very convex at basal four-fifths, depressed and angled ventrally at apical one-fifth; without carinae or sculpturing; setae sparse, pale yellow, curved. Elytral suture fused except for a small notch at the apex; sutural interval weakly carinate at apical one-fifth. Disc with 8 rows of large, shallow punctures mostly spaced about 1 puncture diameter apart: rows 1, 2, 3, 4, and 6 begin near the basal margin; row 5 begins about one-third elytral length from base; row 6 begins in a shallow sulcus adjacent to humeral angle, with punctures in the basal one-third smaller, more closely spaced; row 7 begins about one-sixth elytral length from base; row 8 begins a short distance from base and lies closely adjacent to the lateral edge. Intervals flat except interval 6 weakly convex from humerus to about half the elytral length. Humerus slightly raised.

Epipleuron very wide, band-like, flat, tapering from metaventrite to acute apex; completely covered with dense plastron setae. **Metathoracic wings** present; development undetermined. **Prosternum** (Fig. 8b) long, about as long as metaventrite, length anterior to procoxae subequal to length of prosternal process; disc sparsely setose; chin piece barely declivous anterior to prosternal process, apical margin broadly arcuate. Prosternal process broadly subtriangular; margins thick, reflexed, coarsely granulate; impressed medially between margins, glabrous, rugose, with a few coarse punctures; apex narrowly rounded. **Mesoventrite** (Fig. 8b) very short; disc sparsely setose between mesocoxae, completely covered with plastron setae laterally between meso- and metacoxae; mesoventral cavity deep, margined. **Metaventrite** (Fig. 8b) long, about as long as prosternum. Disc convex, laterally bounded by thick, longitudinal carinae; discrimen complete in a shallow sulcus becoming wider posteriorly. Disc surface sparsely setose medially between meso- and metacoxae, completely covered with plastron setae laterally. Metaventral process semicircular, margined laterally, convex anteriorly, shallowly concave posteriorly. Posteromedial margin laterally adjacent to discrimen with 2 short, acute, posteroventrally directed teeth (Figs. 8b, c). **Legs** (Fig. 8) unusually long in relation to body; metaleg longest, distinctly longer than body length; proleg shortest. Coxae covered with plastron setae; pro- and mesocoxae globular, metacoxae transverse. Femora of all legs covered with plastron setae; profemur with a dense, yellow patch of moderately long, fine, recumbent setae on the mesal anterior surface; mesofemur with a similar patch on the posterior surface; metafemur with none; remaining femoral surfaces with sparse, semierect setae. Tibiae of all legs covered with plastron setae, each with a cleaning fringe; protibia with a thin, apical cleaning fringe about two-thirds tibial length on the anterior surface; mesotibia with a thicker, longer, apical fringe about two-thirds tibial length on the posterior surface; metatibia with a thin, apical fringe about half tibial length on the posterior surface; remaining tibial surfaces covered with long, moderately dense, semierect setae. Tarsi of all legs bearing sparse, scattered, very long setae; tarsomeres 1–4 of each with dense ventral clusters of stiff setae at posterior margins; protarsomere 1 ventral apex with a short spine as wide as the tarsomere; tarsomere 5 longer than 1–4 combined, with a fine apical seta between and as long as claws. Tarsal claws simple, short, moderately stout, acute, darker at tips than bases. **Abdomen** (Fig. 8b) about same length as metaventrite; moderately convex. Surface covered with plastron setae and sparse, short, recumbent setae; ventrites 1–4 each with a fringe of short setae on the posterior margin. Abdominal ventrite 1 between metacoxae with a raised margin enclosing a shallowly concave, granulate, semicircular area; ventrite 2 elevated and granulate near the midline; ventrites 2–4 very short along the midline, ventrites 1–3 longer at lateral margins; ventrite 5 longer than 1–4 combined, subtriangular, anterior margin arcuate, apex broadly rounded, slightly emarginate. **Aedeagus** (Fig. 9) elongate, very narrow. In dorsal and ventral views (Figs. 9a, c): *Phallobase* shorter than parameres and as wide as both paramere bases together. *Parameres* about 1.5× longer than phallobase; each widest at base, then gradually narrowing to become very thin; apex sharply acute; inner margins dorsally carinate and heavily sclerotized at basal half; basal half with several very long, curved, pale setae; apical one-third covered with numerous, very long, thin, curved, pale setae. *Penis* barely longer than parameres; very thin and stiletto-form at apical half; apex blunt, narrowly rounded. In lateral view (Fig. 9b): *Paramere* widest at base, abruptly narrowed at about one-fourth to one-third from base, then gradually narrowed and curved ventrally to apex; dorsal margin sinuate.

Female. Unknown.

Variation. Only one specimen was available for the description, so possible variation is presently unknown. The two spines on the posteromedial margin of the metaventrite are most likely sexually dimorphic and not present in the female.

Comparative Notes. *Nanelmis longicruris* (Fig. 8) may be distinguished from *N. aguaje* (Fig. 1) by the following (*N. longicruris* character state first, *N. aguaje* character state second): metaleg distinctly longer than body vs. about the same length as body; frons granulate vs. frons smooth, not granulate; pronotum slightly wider at base than middle, with small, shallow punctures vs. pronotum wider at middle than at base, with moderately large, deep punctures; pronotum with lateral sides not evenly arcuate, with two pairs of slight angulations vs. lateral sides evenly arcuate; prosternal process impressed medially vs. weakly convex medially; cleaning fringe of protibia nearly two-thirds the tibial length vs. half the tibial length. Note: This comparison is based on a single specimen of *N. longicruris* and 33 specimens of *N. aguaje.*

Larva. The larva of *N. longicruris* is unknown, but that of *N. aguaje* is described in this article. Several larval morphotypes, not yet associated with adults, have been identified in French Guiana (Shepard *et al*. 2020). Of these, Larva V and Larva Y have been collected at the type locality of *N. longicruris*, but neither they, nor any other unidentified larvae, resemble that of *N. aguaje*.

Type Specimen. Holotype ♂, pinned, deposited in the MNHN. **FRENCH GUIANA.** "FRENCH GUIANA / Crique Chicot / ~5 km S Javouhey / 05.5610°, -53.8315° / 26-III-2017, A. Cerdan // [genitalia in vial below specimen] // HOLOTYPE / Nanelmis / longicruris / Barr [red, handwritten label]".

Etymology. The species name, *longicruris*, is an adjective formed from the Latin words *longus*, meaning "long", and *cruris*, meaning "leg", to highlight the unusually long legs of this species.

Distribution. *Nanelmis longicruris* is known only from the type locality in northwestern French Guiana, approximately 23 km northeast of Saint-Laurent-du-Maroni near the Suriname border.

Habitat. Crique Chicot (Fig. 11), a tributary of Crique Sainte-Anne which is a tributary of the Acarouany River, is a small stream flowing through a riparian corridor of remnant forest in the midst of agricultural fields. At the time of sampling, the stream was about 0.5 to 1.2 m deep, with a predominantly sand bottom which was soft and silty in spots; the water was cool, tannin-stained orange-brown, and had a moderate flow. The single specimen of *N. longicruris* was collected from a riparian vegetation root mass which was suspended in the water. Most of the other elmids collected at the site were among leaf litter or on waterlogged wood.

Water quality measurements taken at the time of the collection were: dissolved oxygen = 5.7 mg/L (71.7% saturation); temperature = 26.6 C; pH = 5.61; conductivity = 32.2 µS/cm; and turbidity = 5.56 NTU.

Associated Aquatic Coleoptera. Elmidae: *Gyrelmis brunnea* Hinton, *Gyrelmis* sp., *Heterelmis* sp., *Hexacylloepus* Hinton sp., *Hintonelmis cf. perfecta* (Grouvelle), *Macrelmis* Motschulsky sp., *Microcylloepus* Hinton sp., *Neoelmis* Musgrave sp., *Neolimnius palpalis* Hinton, *Stenhelmoides* sp., Larva V and Larva Y (larvae unassociated with adults; Shepard *et al*. 2020), and an unidentified, flat-spined larva. At least 10 dryopoid genera were collected from Crique Chicot when it was first sampled in 2017, but only four genera were collected in 2022. In 2017, most specimens were found among leaf litter, which was scarce in 2022, or on waterlogged wood. Dytiscidae: *Anodocheilus venezuelanus* García; *Bidessodes charaxinus* Young; *Copelatus* Erichson sp.; *Laccophilus* Leach sp.; *Vatellus tarsatus* Laporte (D. L. Post, *in litt.*).

Remarks. The single male specimen has a pair of ventrally directed, acute teeth on the posteromedial margin of the metaventrite (Figs. 8b, c) and a short ventral spine on each protarsomere 1, characteristics that are likely secondarily sexually dimorphic. After AC collected the type specimen at Crique Chicot, two other unsuccessful attempts were made to find more specimens, one by CBB and W. D. Shepard, and one by AC.

Discussion

The very small body size of *Nanelmis* makes specimens very difficult to see among the woody debris, leaves, and silt captured in the net during sampling. As a result, in Peru, only five specimens of *N. aguaje* were found during 13 sampling events at four sites along the stream at Finca las Piedras in 2022 and 2023. In 2024, our success in capturing a sizeable series of adults can be credited to the use of a fine mesh net and a sheeting technique. Collection of bulk debris samples led to discovery of the larva, which was not seen in the field during sampling. In French Guiana, only a single specimen of *N. longicruris*, collected in 2017, was found during three collecting events.

It is an enigma that no males of *N. aguaje* were found and that the entire series of 33 adults consists solely of females. This is a highly unusual situation, perhaps unheard of, for elmines because of their life history which includes longevity as adults and overlapping generations. One intriguing possibility is that perhaps some sort of reproductive manipulator is involved, such as *Wolbachia* intracellular bacteria. *Wolbachia* are common endosymbionts in many arthropods, infecting an estimated 40% of terrestrial species (Zug and Hammerstein 2012) and 52% of aquatic species (Sazama *et al.* 2017). These bacteria are primarily reproductive parasites which manipulate the host biology in diverse ways, which can result in the elimination of males in the population (Werren *et al*. 2008). Sazama *et al.* (2017) found *Wolbachia* occurred in 53% of aquatic Coleoptera species surveyed, but in general there has been little research involving aquatic insects (M. Turelli, personal communication).

The lowland stream habitats of both *Nanelmis* species are threatened by deforestation and agricultural expansion. At the type locality of *N. aguaje*, the very small stream (Fig. 10) is nearly surrounded by fields, some of which were cleared of forest after the discovery of the species in 2022. In French Guiana, the larger stream where *N. longicruris* occurs (Fig. 11) is embedded in a riparian corridor amid a patchwork of cultivated fields. Although almost certainly the species are not restricted to these two streams, their situation highlights an accelerating, cumulative trend whereby such watercourses are affected by canopy removal, siltation, agricultural enrichment, and pesticides to the detriment of their ecosystems.

Nanelmis is the second new genus, after *Amazonopsis*, to be found in the lowlands of both Peru and French Guiana in recent years (Barr 2018). A specimen of *Nanelmis* from the southeastern corner of Colombia near the border with Brazil and Peru, possibly representing an undescribed third species, has been discovered by elmid researcher Marcela González-Córdoba.

Acknowledgments

First and foremost, Geoffrey Gallice of the Alliance for a Sustainable Amazon and Johana

Figs. 10–11. *Nanelmis*, **new genus**, type localities. **10)** *N. aguaje*, **new species**, Quebrada Aguajal, Finca las Piedras, Madre de Dios, Peru; **11)** *N. longicruris*, **new species**, Crique Chicot, NE of Saint-Laurent-du-Maroni, French Guiana.

Reyes Quinteros of the Alianza para una Amazonía Sostenible Perú and Finca Las Piedras, are gratefully acknowledged for their logistical support in Peru and for reviewing parts of this manuscript. We also thank Peru's Servicio Nacional Forestal y de Fauna Silvestre (SERFOR) for granting permission to conduct field work at Finca Las Piedras (RDG No. D000443-2021-MIDAGRI-SERFOR-DGGSPFFS).

Marcela González-Córdoba, at CIEMEP - CONICET, UNPSJB, Esquel, Argentina and Universidad del Valle, Cali, Colombia, generously shared her independent discovery of the new genus and provided information and insights concerning its affinities. Thiago Polizei, University of São Paulo, Brazil and Raul Bismarck Pinedo Garcia of Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil provided detailed advice that aided in the preparation of mouthparts for imaging. Bill (W. D.) Shepard, Essig Museum of Entomology, although not a coauthor, was instrumental in helping to collect the type series of *N. aguaje* and was responsible for discovering the larvae. This article was greatly improved because of our invaluable discussions about its content and his involvement with the project in both the field and the lab.

Chris Grinter, Entomology Department, California Academy of Sciences, San Francisco generously provided access to their imaging system, and Rachel Diaz-Bastin assisted us with photographing specific features. Likewise, Kipling Will, Essig Museum of Entomology, University of California, Berkeley allowed us to use his imaging system for the habitus photos and suggested *Wolbachia* bacteria as a possibility in connection with the all-female type series of *N. aguaje*. Michael Turelli, University of California, Davis, and expert on the bacteria, shared background information and encouraged investigation of *Wolbachia* in the species.

Thiago Polizei and an anonymous reviewer are thanked for their constructive comments and recommendations which helped improve to this article.

References Cited

Barr, C. B. 2018. *Amazonopsis*, an unusual new genus of riffle beetle from South America with two new species (Coleoptera, Elmidae, Elminae). ZooKeys 803: 71–92. doi.org/10.3897/zookeys.803.28124

González-Córdoba, M., V. Manzo, and C. E. Granados-Martínez. 2021. *Zunielmis pax*, a new genus and species of riffle beetles (Coleoptera: Elmidae) from Colombia. Zoosystematica Rossica 30(2): 248–265.

González-Córdoba, M., N. R. Martínez-Román, M. del C. Zúñiga, V. Manzo, and M. Archangelsky. 2020. Description of the putative mature larva of the Neotropical genus *Stenhelmoides* Grouvelle (Coleoptera: Elmidae). Scientific Reports 10, 6191, 1–14.

Hinton, H. E. 1941. New genera and species of Elmidae (Coleoptera). Transactions of the Royal Entomological Society of London 91(3): 65–104.

Jäch, M. A., J. Kodada, M. Brojer, W. D. Shepard, and F. Čiampor, Jr. 2016. Coleoptera: Elmidae and Protelmidae. World Catalog of Insects, Vol. 14. Brill, Leiden, The Netherlands, 318 pp.

Manzo, V. 2005. Key to the South America genera of Elmidae (Insecta: Coleoptera) with distributional data. Studies on Neotropical Fauna and Environment 40(3): 201–208.

Manzo, V., and M. Archangelsky. 2008. A key to the known larvae of South American Elmidae (Coleoptera: Byrrhoidea) with a description of the mature larva of *Macrelmis saltensis* Manzo. Annales de Limnologie - International Journal of Limnology 44(1): 63–74.

Sazama, E. J., M. J. Bosch, C. S. Shouldis, S. P. Ouellette, and J. S. Wesner. 2017. Incidence of *Wolbachia* in aquatic insects. Ecology and Evolution 7(4): 1165–1169.

Segura, M. O., F. Valente-Neto, and A. A. Fonseca-Gessner. 2011. Elmidae (Coleoptera, Byrrhoidea) larvae in the state of Sao Paulo, Brazil: Identification key, new records and distribution. ZooKeys 151: 53–74.

Shepard, W. D. 2019. Flight wing polymorphisms in Elmidae and Dryopidae (Coleoptera: Byrrhoidea). The Coleopterists Bulletin 73(1): 27–44.

Shepard, W. D., S. Clavier, and A. Cerdan. 2020. A generic key to the known larval Elmidae (Insecta: Coleoptera) of French Guiana. Papéis Avulsos de Zoologia 60(special issue), e202060(s.i.).15, 1–9.

Sites, R. W. 2023. A new species of *Maculambrysus* Reynoso & Sites, 2021 (Hemiptera: Heteroptera: Naucoridae) from an aguaje palm swamp in southeastern Peru. Zootaxa 5389(2): 288–294.

Werren, J. H., L. Baldo, and M. E. Clark. 2008. *Wolbachia*: Master manipulators of invertebrate biology. Nature Reviews Microbiology 6: 741–751.

Zug, R., and P. Hammerstein. 2012. Still a host of hosts for *Wolbachia*: Analysis of recent data suggests that 40% of terrestrial arthropod species are infected. PLoS ONE 7(6), e38544. doi:10.1371/journal.pone.0038544

(Received 24 October 2024; accepted 16 July 2025. Publication date 19 September 2025.)