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Two new species of the millipede genus *Trichomorpha* Silvestri, 1897 from central Ecuador (Diplopoda: Polydesmida: Chelodesmidae)

Два новых вида диплопод рода *Trichomorpha* Silvestri, 1897 из Центрального Эквадора (Diplopoda: Polydesmida: Chelodesmidae)

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ABSTRACT. Two new *Trichomorpha* are described and illustrated from Ecuador: *T. telnovi* sp.n. from the Pastaza Province and *T. similis* sp.n. from the Tungurahua Province. Both new forms seem to be the first in the large Neotropical genus *Trichomorpha* that encompasses about 40 nominal species and ranges from Costa Rica in the north to Colombia and Ecuador in the south to be properly described and thoroughly illustrated. Both are also only the second and third congeners to be recorded from Ecuador.

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РЕЗЮМЕ. Из Эквадора подробно описаны и снабжены иллюстрациями две новые многоножки-диплоподы: *Trichomorpha telnovi* sp.n. из провинций Пастаса и *T. similis* sp.n. из провинции Тунгурауа. Вероятно, обе новые формы — первые в большом неотропическом роде *Trichomorpha*, включающему около 40 номинальных видов и распространенному от Коста-Рики на севере до Колумбии и Эквадора на юге, которые по-настоящему хорошо описаны и полно проиллюстрированы. Оба также лишь второй и третий виды рода, отмеченные в Эквадоре.

Introduction

The millipede family Chelodesmidae is the second largest in the entire class Diplopoda, following the Paradoxosomatidae with its 1000+ species and about 200 genera. The Chelodesmidae presently encompasses more than 750 species in 176 genera, 21 tribes (most genera still being unassigned to a tribe) and two geographic subfamilies: the Neotropical Chelodesminae and the basically Afrotropical Prepodesminae [Means *et al*., 2023].

The genus *Trichomorpha* Silvestri, 1897 is among the largest in the Chelodesminae, together with several other, much smaller genera forming the tribe Trichomorphini and presently comprising about 40 nominal species that range from Costa Rica in the north to Colombia and Ecuador in the south [Hoffman, 1999]. Given that several species can occur in sympatry or even syntopy [Carl, 1914; Hoffman, 1979], the real diversity of *Trichomorpha* is currently strongly underestimated [Jeekel, 1986] and actually it may well amount to 200 species [Hoffman, 1979]. Among the described members, 26 occur within the Tropical Andes Biodiversity Hotspot: 22 in Colombia, one in Ecuador, and three in Venezuela [Means *et al.*, 2023].

As Hoffman [1979] noted, *Trichomorpha* seems to be a relatively young and advanced genus still at a stage of active speciation and range expansion, this having allowed several species from the northern Andean core area to cross the Panamanian Isthmus and reach as far north as Costa Rica.

Only one *Trichomorpha* species has hitherto been recorded from Ecuador, more precisely, its southern part: *T. elegans* Silvestri, 1897, the type species, from Gualaquiza, Morona Santiago Province [Silvestri, 1897]. Prompted by the discovery of two new congeners, this time from the Pastaza and Tungurahua provinces, central Ecuador, the present note is devoted to their descriptions.

Materials and Methods

The material underlying the present contribution is in 75% ethanol, taken by Dmitry Telnov, and donated to the collection of the Zoological Museum of the Moscow State University (ZMUM), Moscow. Colour photographs were taken at the Paleontological Institute, Russian Academy of Sciences (PIN), Moscow, using a Flexacam C1 camera mounted on a Leica M165C stereo microscope with built-in LasX software. SEM samples were coated with gold and SEM micrographs were obtained using a Tescan Vega 2 or Tescan Vega 3 electron scanning microscope (Brno, Czech Republic). Image processing was performed utilizing Adobe Photoshop CC software.

The terminology of gonopodal structures largely follows that of Bouzan *et al*. [2024].

Figs 1–7. *Trichomorpha telnovi* sp.n., ♂ holotype. 1 — habitus, lateral view; 2, 3 — anterior half of body, dorsal and ventral views, respectively; 4, 5 — posterior half of body, dorsal and ventral views, respectively; 6 — sterna between legs 4–7, ventral view; 7 — telopodite of leg 14, lateral view. Scale bars: 1.0 mm (1–5), taken not to scale (6), and 0.5 mm (7). Photographs courtesy R. Rakitov.

Рис. 1–7. *Trichomorpha telnovi* sp.n., голотип ♂. 1 — общий вид, сбоку; 2, 3 — передняя половина тела, соответственно сверху и снизу; 4, 5 — задняя половина тела, соответственно сверху и снизу; 6 — стерниты между ногами 4–7, снизу; 7 — телоподит ноги 14, сбоку. Масштаб: 1,0 мм (1–5), без масштаба (6) и 0,5 мм (7). Фотографии любезно сняты Р. Ракитовым.

Taxonomy

Genus *Trichomorpha* Silvestri, 1897

Type species: *T. elegans* Silvestri, 1897, by monotypy.

DIAGNOSIS (modified after Attems [1938] and Hoffman [1979]). A genus of Trichomorphini characterized primarily by the absence of a central sternal sclerite of the gonopods, the gonocoxite (**Cx**) that bears a conspicuous distomesal apophysis (**cp**) near a usual cannula (**ca**), the prefemorite (= densely setose part, **Pf**) being short to moderate, and the femorite strongly reduced to absent, topped by an acropodite (**AP**), this being complex, usually devoid of a basal constriction and carrying several branches or lobes. A flagelliform solenomere (**sl**), a separate long to rather short branch, originates from the prefemorite (**Pf**) and is at least partly sheathed and protected by acropodite branches or lobes (e.g., **APa**, **APb, APc, APd**). A distict prefemoral process typical of most Chelodesminae and located next to the junction of the coxite (**Cx**) to telopodite (**Te**) is absent. The body is small to medium-sized (10–33 mm long), with 20 rings, metaterga smooth and shining to dull, granulate, (micro) tuberculate and poorly to densely setose. The paraterga are well-developed, set high, wing-shaped, thin blades sometimes indentated at lateral margin and acute caudally. The pore formula is normal (5, 7, 9, 10, 12, 13, 15–19). At least anterior ♂ legs with chelae, i.e. distoventral apical pads of tibiae subtending the tarsi. ♂ sternal and other leg modifications often present. The gonopodal aperture is transversely oval, relatively small, simple, covering most of the ventral part of ♂ metazonum 7, but not shifted onto prozonum 7.

COMPOSITION. About 40 nominal species ranging from Costa Rica in the north to Colombia and Ecuador in the south [Hoffman, 1999].

Trichomorpha telnovi **sp.n.**
Figs 1–12.

Holotype ♂ (ZMUM), central Ecuador, eastern Andes, Prov. Pastaza, 18–21 km N of Puyo, up to 3 km around, S 1º18′25″, W 77º57′1″, "Tamandua" ecolodge, 1060–1000 m a.s.l., primary lower montane rainforest (Figs 27, 28), 10–12.II.2023, D. Telnov leg.

NAME. Honours Dmitry Telnov (The Natural History Museum, London, U.K.), the collector.

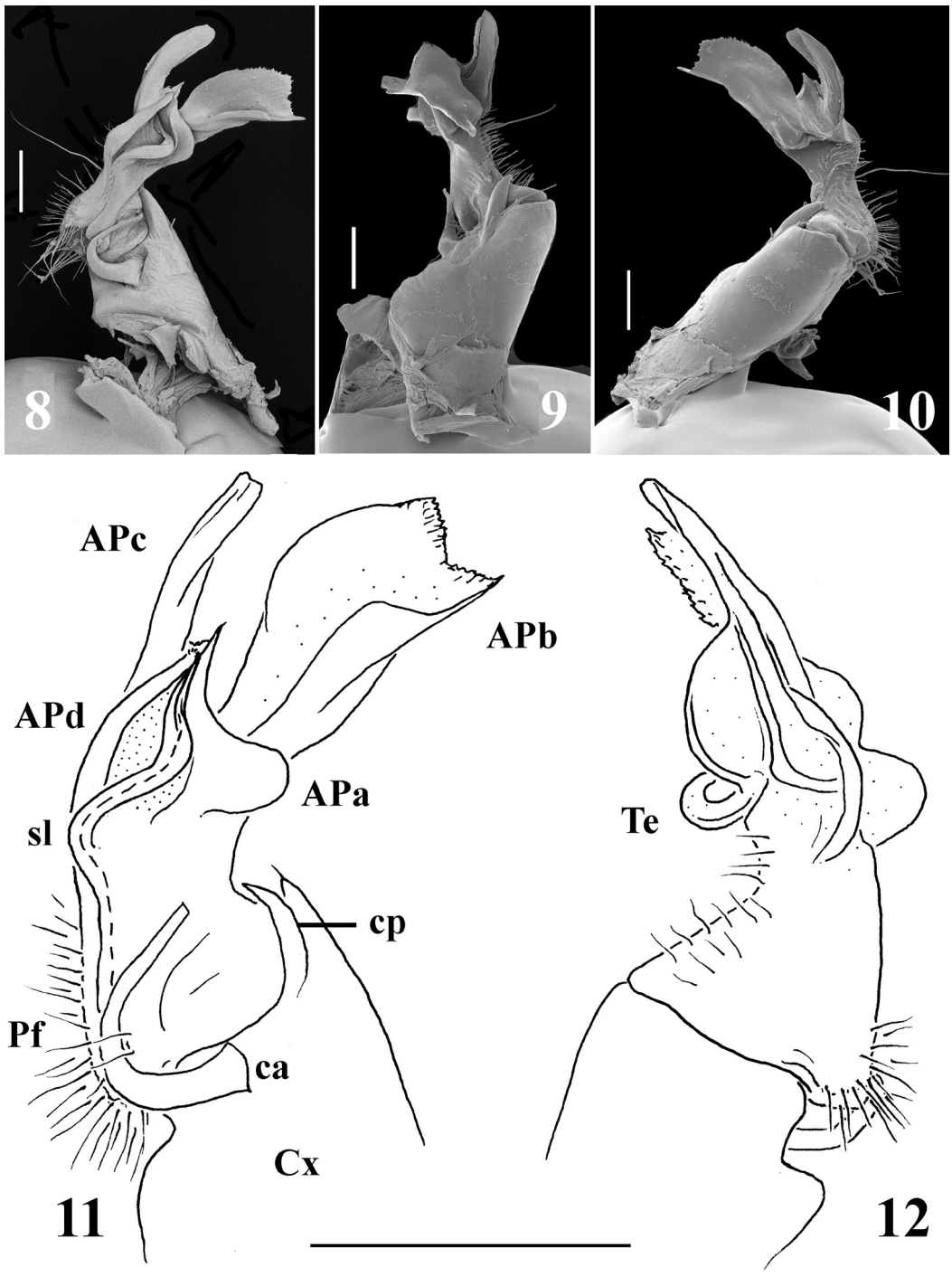
DIAGNOSIS. Differs from congeners by the following combination of characters: body submoniliform due to strong strictures between pro- and metazona; tegument mostly shining; metaterga roughly and densely granulate and setose, paraterga mostly slightly upturned, thin, laterally incised blades with invariably very sharp caudal teeth; transverse metatergal sulci mostly indistinct and traceable on rings 7–17; pleurosternal carinae regularly arcuate, increasingly reduced and partly granulate ridges present on rings 2–18; gonopores inconspicuous, not borne on gonapophyses; sterna largely unmodified, flat, only axial line distinct, and only sterna between ♂ legs 4 and 6 each with a paramedian pair of small, subcontiguous, ribbon-shaped, apically rounded and infuscate processes slightly elevated above venter; ♂ legs extremely and increasingly long, unmodified and devoid of adenostyles, prefemora bulged laterally, legs 1–15 each with a chela (increasingly reduced apical tibial pads subtending remarkably shortened, but increasingly long tarsi) (Figs 1–7); gonopods remarkably complex (Figs 8–12), coxite (**Cx**) unusually poorly setose (with only two short distodorsal setae), with a distinct, distomesal, acuminate process (**cp**) and a usual, unci- and tubiform cannula, solenomere (**sl**) flagelliform and unusually strongly shortened, being subtended, supported and partly sheathed by as many as four characteristically shaped and mostly longer acropodital processes/branches (**APa**, **APb**, **APc** and **APd**).

DESCRIPTION. Length *ca* 21 mm, width of midbody pro- and metazona 1.5 and 1.8 mm, respectively. Colouration in alcohol mostly uniformly chocolate brown, but coxae and prefemora contrasting whitish to very light grey, remaining podomeres and antennomeres, as well as caudal tips of paraterga largely light brown, and apical parts of podomeres and antennomeres even lighter, nearly pallid (Figs 1–5).

Body with 20 rings. Tegument mainly shining, surfaces of prozona and strictures smooth, below paraterga extremely finely microgranulate, collum and following metaterga roughly granulate. Head microgranulate and densely setose/pilose throughout; epicranial suture thin, but rather distinct; genae roundish; interantennal isthmus ca 1.1x diameter of antennal socket (Figs 1, 3). Antennae rather long and clearly clavate, *in situ* reaching back past ring 3 when stretched dorsally, very densely setose, antennomeres 5 and 6 each subapically with a dorsal field of microscopic sensilla. In length, antennomere 2=3=4>5=6>>1=7. In width, head = rings 5–16 > 2–4 > collum; body gradually tapering towards telson on rings 17–20 (Figs 1–5). Collum transversely suboval, regularly and broadly rounded both anteriorly and laterally, densely and irregularly granulate/microtuberculate and setose; caudolateral corner with a short and sharp spine each side. Following metaterga each with 6–8 transverse and rather irregular rows of setigerous grains or oblong tuberculations (Figs 1–5). Paraterga well-developed blades set high (mostly at upper ¼ body), only a little thicker on pore-bearing rings than on poreless ones, largely slightly upturned, thus leaving the dorsum only faintly convex (Figs 1. 2. 4); paraterga drawn increasingly dorsocaudad, all caudal corners sharp, denti- to styliform and increasingly produced past rear tergal margin; posterior margins entire, clearly and regularly emarginate behind paraterga (Figs 1–5). Metatergal setae simple, borne on grains or tuberculations, *ca* 1/4–1/5 as long as metaterga, extending to lateral, indentated and thin margins of paraterga. Pleurosternal carinae regularly arcuated and partly granulated ridges present on rings 2–18, devoid of teeth or lobes (Fig. 1). Ozopores inconspicuous, each opening dorsolatrerally, lying inside a narrow and oblong groove at base of caudal tooth on pore-baring rings 5, 7, 9, 10, 12, 13, 15–19 (Figs 1, 2, 4). Strictures between pro- and metazona narrow, deep and smooth. Epiproct small, conical and subtruncate at tip, with evident lateral pre-apical papillae (Figs 4, 5). Hypoproct roundly subtrapeziform, with 1+1 setae borne on distinct knobs at caudal margin (Fig. 5). An axial line missing. Limbus very thin, small and entire.

Spiracles small and inconspicuous. Sterna poorly setose, mostly flat, axial ventral line being better discernible than transverse impression, mostly with a barely visible round knob near each coxa and with two paramedian pairs of small, subcontiguous, ribbon-shaped, apically rounded and infuscate processes, one between legs 4 and the other between legs 6 (Fig. 6), all four processes being only slightly elevated above venter (♂). Gonopores inconspicuous, not borne on gonapophyses. Legs strikingly long and slender (♂), clearly and increasingly long towards telson, >3–5x as long as midbody height, devoid of adenostyles; prefemora bulged laterally, legs 1–15 each with a chela (increasingly reduced apical tibial pads subtending remarkably shortened, but increasingly long tarsi) (Figs 1–7); claws very small. All podomeres faintly clavate, but only femora slightly curved ventrad (Fig. 7). In length, midbody femora > tibiae > postfemora > tarsi > prefemora > coxae.

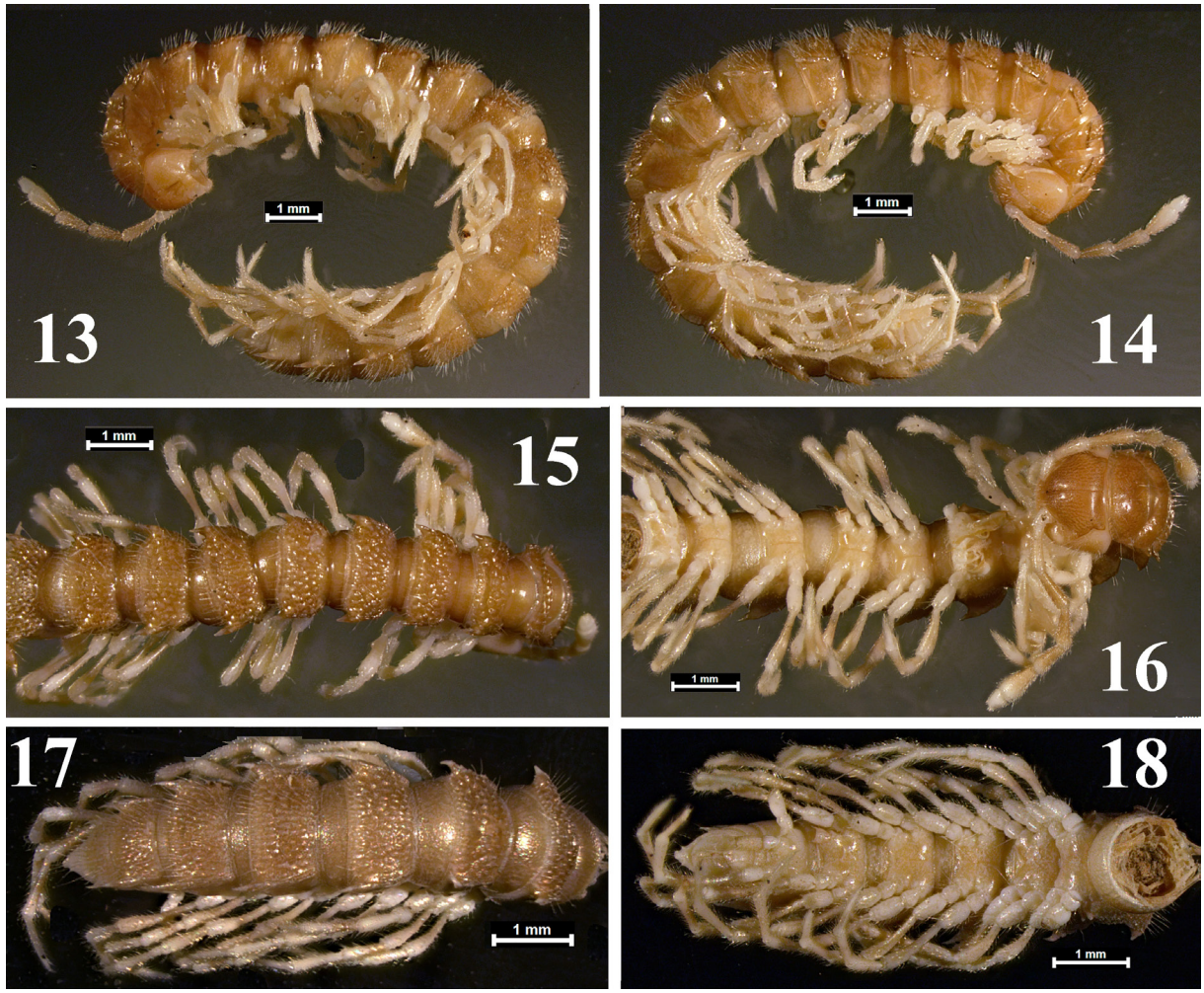
Gonopodal aperture rather small, but taking up most of ventral side of metazonum 7, not shifted onto prozonum 7,



Figs 8–12. *Trichomorpha telnovi* sp.n., ♂ holotype, right gonopod, mesal, anteroventral, lateral, mesal and posteroventral views, respectively. Scale bars: 0.2 mm (SEM, 8–10) and 0.5 mm (11, 12). Designations explained in text. SEM micrographs courtesy R. Rakitov.

Рис. 8–12. *Trichomorpha telnovi* sp.n., голотип ♂, правый гонопод, соответственно изнутри, одновременно спереди и снизу, сбоку, изнутри и одновременно сзади и снизу. Масштаб: 0,2 мм (SEM, 8–10) и 0,5 мм (11, 12). Объяснения обозначений в тексте. Микрографии SEM любезно сняты Р. Ракитовым.

transversely oval, only its lateral walls slightly and regularly elevated. Gonopods (Figs 3, 8–12) devoid of a central sternal sclerite, small, *in situ* held parallel to each other and directed anteroventrally. Coxite (**Cx**) somewhat shorter than telopodite (**Te**), subcylindrcal, with only two short setae, one apicodorsal, the other subapical mesal and located at base of a conspicuous, small, slightly curved, acuminate, mesal coxal process (**cp**), cannula (**ca**) as usual, unci- and tubiform. A femorite virtually fully reduced. A free solenomere (**sl**) flagelliform and clearly shortened, being subtended, supported and partly sheathed by as many as four characteristically shaped and mostly longer acropodital processes (**APa**, **APb**, **APc** and **APd**), both **APb** and **APc** being the longest branches, **APc** slender and slightly coiled, and **APb** a large lamelliform velum with a fringed apex.



Figs 13–18. *Trichomorpha similis* sp.n., ♂ holotype. 13, 14 — habitus, left lateral and right lateral views, respectively; 15, 16 — anterior half of body, dorsal and ventral views, respectively; 17, 18 — posterior half of body, dorsal and ventral views, respectively. Scale bars: 1.0 mm. Photographs courtesy R. Rakitov.

Рис. 13–18. *Trichomorpha similis* sp.n., голотип ♂. 13, 14 — общий вид, соответственно слева и справа сбоку; 15, 16 — передняя половина тела, соответственно сверху и снизу; 17, 18 — задняя половина тела, соответственно сверху и снизу. Масштаб: 1,0 мм. Фотографии любезно сняты Р. Ракитовым.

Trichomorpha similis **sp.n.**
Figs 13–26.

Holotype ♂ (ZMUM), central Ecuador, eastern Andes, Prov. Tungurahua, ~5–6 km N Rio Negro, 1°21′47″S 78°12′16″W to 1°21′45″S 78°11’59″W, “Ecominga” private reserve, 1580–1775 m a.s.l., secondary mid-montane rainforest (*ca* 20–25 years old, with remaining banana plants), very wet and thin litter (Figs 29, 30), 7–9.II.2023, D. Telnov leg.

NAME. To emphasize the particular proximity and similarity, both geographic and morphological, to *T. telnovi* sp.n.

DIAGNOSIS. Both above new species are definitely very similar to each other, sharing nearly all somatic characters, coupled with basically the same gonopodal conformation. The differences are presented just below.

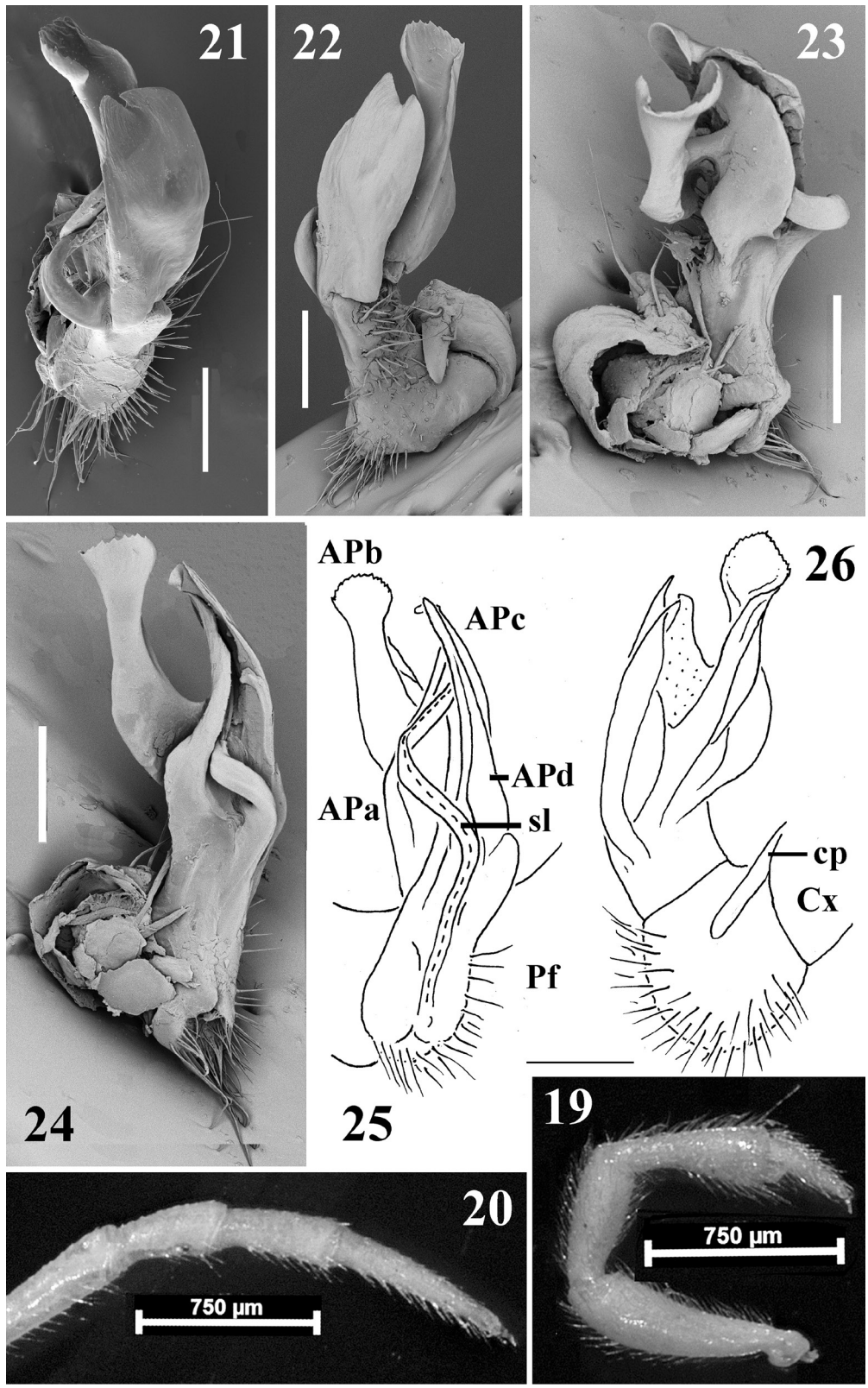
DESCRIPTION. Length *ca* 19 mm, width of midbody pro- and metazona 1.4 and 1.7 mm, respectively. Colouration in alcohol mostly uniformly light brown, only anterior body quarter a little darker, increasingly yellowish to pallid towards telson; distal half of antennomere 6 and entire antennomeres 7 and 8, legs, venter and telson pallid (Figs 13–18).

All other characters as in *T. telnovi* sp.n. (Figs 13–20), except as follows.

Paraterga mostly set a little lower, largely subhorizontal and not so clearly upturned caudally (Figs 13, 14). Legs largely a little shorter, mostly up to 4x as long as midbody height (Figs 13–18), podomeres being shorter (Figs 19, 20). A paramedian pair of 1+1 small, sharp, well separated prongs directed anteroventrally between coxae 4 and a similar, but even smaller pair of well separated knobs directed anteriorly between coxae 6 (♂).

Gonopods (Figs 21–26) with the same structural elements as in *T. telnovi* sp.n., but each coxite (**Cx**) with a few distodorsal setae, at least two being very strong, and acropodite branches and lobes slightly different in shape: lobe at base of **APa** indistinct, velum **APb** much more narrow, and process **APc** a large, apically bilobed, broad and dorsally hollow plate slightly curved anteriad.

REMARKS. Based on peripheral, leg and gonopodal characters, both new species also seem to be quite similar to *T. virgata* Carl, 1914, from a few places in Colombia [Carl, 1914], but *T. telnovi* sp.n. readily differs from it and all other congeners except *T. similis* sp.n. primarily by the peculiar gonopodal conformation, in particular the presence and shapes of as many as four acropodital processes and lobes that sheathe, subtend and protect an unusually short solenomere branch. Eventually,



Figs 19–26. *Trichomorpha similis* sp.n., ♂ holotype. 19 — telopodite of leg 9, lateral view; 20 — distal podomeres of a leg of ring 17, lateral view; 21–26 — left gonopod, ventral, ventrolateral, dorsal, mesal, submesal and lateral views, respectively. Scale bars: 0.75 mm (19, 20), 0.2 mm (SEM, 21–24) and 0.2 mm (25, 26). Designations explained in text. SEM micrographs courtesy R. Rakitov.

Рис. 19–26. *Trichomorpha similis* sp.n., голотип ♂. 19 — телоподит ноги 9, сбоку; 20 — дистальные членики ноги туловищного сегмента 17, сбоку; 21–26 — левый гонопод, соответственно снизу, одновременно снизу и сбоку, сверху, изнутри, почти изнутри и сбоку. Масштаб: 0,75 мм (19, 20), 0,2 мм (SEM, 21–24) и 0,2 мм ((25, 26). Объяснения обозначений в тексте. Микрографии SEM любезно сняты Р. Ракитовым.

Figs 27–30. The type localities of *Trichomorpha telnovi* sp.n., views from the "Tamandua" ecolodge (27, 28), and *T. similis* sp.n., views from near the "Ecominga" private reserve (29, 30) (all images courtesy Dmitry Telnov, 2023).

Рис. 27–30. Типовые местности *Trichomorpha telnovi* sp.n., виды из экогостиницы "Tamandua", и *T. similis* sp.n., виды вблизи частного заповедника "Tamandua" (29, 30) (все фотографии любезно предоставлены Дмитрием Тельновым, 2023).

both *T. telnovi* sp.n. and *T. similis* sp.n. appear to be the first *Trichomorpha* species to be properly described and thoroughly illustrated. *Trichomorpha telnovi* sp.n. and *T. similis* sp.n. differ primarily in the mostly clearly upturned paraterga (*vs* not so clearly elevated and largely subhorizontal), longer legs and podomeres (*vs* shorter) and, above all, in some minor details of gonopodal structure (see above).

The three congeners presently known from Ecuador, although all stemming from the eastern versant of the northern Andes, are widely separated from each other not only morphologically, but also geographically: *T. elegans* Silvestri, 1897 is from the Gualaquiza, Morona Santiago Province, southern Ecuador [Silvestri, 1897], *vs T. telnovi* sp.n. from the Pastaza Province, and *T. similis* sp.n. from the Tungurahua Province, both in central Ecuador. All three *Trichomorpha* in Ecuador definitely belong to the Tropical Andes Biodiversity Hotspot.

The type locality of *T. telnovi* sp.n. lies in the footlhills of the eastern Andes, the place supporting a very wet primary cloud forest, while the animal was taken on a clay soil surface with granitic boulders (Figs 27, 28). The type locality of *T. similis* sp.n. is a secondary, young, mid-montane rainforest with admixtures of agricultural plants and a thin layer of litter (Figs 29, 30).

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