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# Acarine Biodiversity in Ecuador: Two New Species of Endoparasitic Chiggers (Acarina: Trombiculidae) from Terrestrial Andean Anurans

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## Abstract

Two species of endoparasitic chiggers, *Vercammenia neotropica* n. sp. and *Microtrombicula ecuadorensis* n. sp., are described, both found in terrestrial anurans of the genus *Pristimantis* collected in the Andes of Ecuador. A new combination is proposed for *Trombicula yorkei* Sambon, 1928 as *Microtrombicula yorkei* (Sambon, 1928) n. comb., and *Schoengastia lynni* Ewing, 1942 is placed as *incertae sedis*. This is the first record of species of the genus *Vercammenia* in the Neotropical region.

**Keywords:** *Vercammenia*, *Microtrombicula*, *Pristimantis*, Ecuador

## Resumen

Dos especies de ácaros endoparásitos, *Vercammenia neotropica* n. sp. y *Microtrombicula ecuadorensis* n. sp., son descritas, ambas encontradas en anuros terrestres del género *Pristimantis* recolectados en los Andes de Ecuador. Se propone una nueva combinación para *Trombicula yorkei* Sambon, 1928 como *Microtrombicula yorkei* (Sambon, 1928) n. comb., y *Schoengastia lynni* Ewing, 1942 se coloca como *incertae sedis*. Este es el primer descubrimiento de especies género *Vercammenia* en la Región Neotropical.

**Palabras Claves:** *Vercammenia*, *Microtrombicula*, *Pristimantis*, Ecuador

## Introduction

The species of mites known from the family Trombiculidae number in the range of 2,500 to 3,000 (see Fernandes and Kulkarni, 2003; Gazêta et al., 2006; Stekolnikov and Daniel, 2012). These mites usually occur as ectoparasites mainly of mammals and birds, although some are parasites of frogs and toads (Krantz and Walter, 2009) and invertebrates

(Vercammen-Grandjean and Benoit, 1971), or endoparasites in vertebrates (Yunker and Jones, 1961; Brennan and Yunker 1966, 1969; Nadchatram, 2006). In frogs and toads, most known species are intradermal. Three genera have been described that include species of endoparasites from anurans: *Hannemania* Oudemans, 1911 in the New World, *Endotrombicula* Ewing, 1931 in Africa, and *Vercammenia* Audy and Nadchatram, 1957 in Southeast Asia and Australia. Two

other species have been described from the neotropics, still with uncertain status: *Vercammenia yorkei* (Sambon, 1928) in *Hyla rubra* from Brazil and *Schoengastia lynni* Ewing, 1942 "on frog" [sic] from Jamaica.

In a survey of frogs of the genus *Pristimantis* in the central and southern Andes of Ecuador, several specimens were found to be infected by intradermal chiggers (Trombiculidae); close examination of these mites showed two new species, and both are described in the next section.

## Material and Methods

Frogs that were collected in the field were euthanized with 20% benzocaine, fixed in 10% formalin, and stored in 70% ethanol. Host vouchers were deposited at the herpetological collection of the Instituto Nacional de Biodiversidad (INABIO) in Ecuador.

Chiggers that were found in cysts or free under the skin were removed and preserved in 70° ethanol, and some were mounted in Hoyer's medium on a microscope slide under a no. 1 cover slip. Measurements were taken with Nikon Labophot YF-21E microscope with Camera DS-Fi1 with Control Unit DS-L2 software; these are given in micrometers (µm) as follows: holotype, mean with range of standard characters given in parentheses.

A camera lucida (drawing tube) was used to draw specimens; line drawings were edited with Adobe Photoshop CS6. Nomenclature of measured morphological structures and diagnostic formulas follow Goff et al. (1982) and Stekolnikov (2012). All type specimens have been deposited in the Colección de Acaros, Instituto Nacional de Biodiversidad (AC-INABIO) Quito, Ecuador and Colección de Parasitología, Museo de Biología, Universidad Central de Venezuela (CP-MBUCV), Caracas, Venezuela.

## *Vercammenia neotropica* n. sp.

(Figs. 1, 3, 4, 5, 6; Tables 1, 2)

**Diagnosis:** SIF = 7B.S-N-3-3111.0000; fPp = B/B/NNB; Pc = 3; fCx = 1.1.1.1; fSt = 2.2; fSc = PL > AL = AM; fD = 2H-6-6-4-2; fV = 2-2-2-4-2-4u-2; DS = 20; VS = 14; NDV = 34; Ip = 620-707; H = (40-53); D<sub>min</sub> = (47-50); D<sub>max</sub> = (50-56); V<sub>min</sub> = (31-45); V<sub>max</sub> = (33-43); pa = (217-254); pm = (189-205); pp = (209-246).

**Description (larvae n = 17):** Larvae in cysts embedded in the skin.

**IDIOSOMA:** 309, 397 (162-663) long and 224,293 (130-520) wide. Eyes 2 pairs, eyes of each pair not in a common plate; anterior eye rounded and bigger, posterior lightly elongated in anterior-posterior axis and smaller. Humeral setae one pair, similar to other dorsal setae with short barb 46, 48 (40-53) long. Dorsal setae decreasing in length posteriorly, anterior setae 52, 53 (50-56) and posterior 48, 49 (47-50) long, fD 2H-6-6-4-2. Ventral side with 2-2 sternals similar in size and shape measuring the anterior pair 35, 38 (33-43) and the posterior pair 40, 39 (31-45), caudal setae 52, 47 (38-53), fV 2-2-2-4-2-4u-2. Total number of idiosomal setae excluding coxal 38.

**GNATHOSOMA:** 67, 72 (59-80) long. Cheliceral blade with tricuspid cap wider in the base. Gnathobase with single pair of branched setae; galeala nude; palpal femur and genu with one branched seta; dorsal and lateral tibial setae nude and ventral seta branched; palpal tarsus with 7 branched setae, subterminala and tarsala; palpal claw with 3 prongs, one ventral and two dorsal.

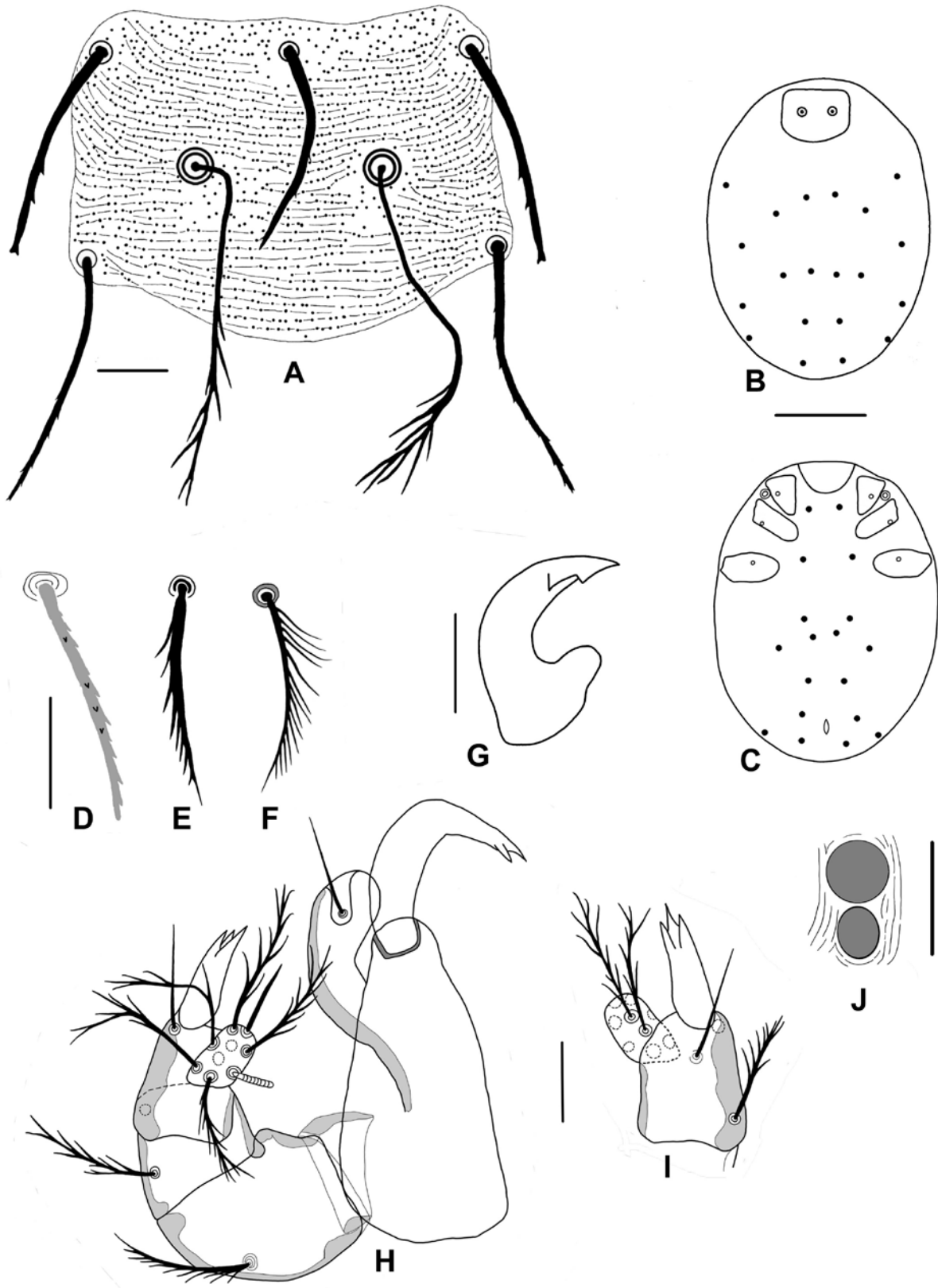
**SCUTUM:** Rectangular, with rounded posterior margin, and punctuations connecting by thin horizontal lines; AM base at same level than ALs; sensillae far anterior to level

**Table 1.** *Vercammenia neotropica* n. sp. measurements of scutal and humeral setae of the type-series

	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	S
Holotype	67	71	31	26	32	58	34	32	29	58	68
Minimum	53	55	29	20	23	47	30	27	29	51	40
Maximum	72	76	35	29	36	62	41	38	44	63	68
Mean	65	70	32	24	31	56	37	34	36	55	59
St. Dev.	4.8	4.6	1.8	2.7	3.0	4.4	2.6	2.8	3.3	2.9	3.9

**Abbreviations:** AW = distance between ALs; PW = distance between PLs; SB = distance between sensillary bases; ASB = distance from level of sensillary bases to extreme anterior margin of scutum; PSB = distance from level of sensillary bases to extreme posterior margin of scutum; SD = length of scutum (ASB + PSB); AP = distance from AL to PL on one side; AM = length of tanteromedian setae; AL = length of anterolateral setae; PL = length of posterolateral setae; S = length of sensilla.

(n = 17)



**Figure 1.** *Vercammenia neotropica* n. sp. A, scutum; B, arrangement of dorsal idiosomal setae; C, arrangement of ventral idiosomal setae; D, dorsal idiosomal seta; E, ventral idiosomal seta; F, sternal seta; G, cheliceral blade; H, gnathosoma, ventral view; I, palpal tibia and tarsus, dorsal view; J, eyes. Scale bars: A, G, H, I = 10 µm; D, E, F, J = 25 µm; B, C = 100 µm.

**Table 2.** *Vercammenia neotropica* n. sp. measurements of modified setae of the legs of the type-series

	Tarsus					Tibia			Genu			
	tar	pret	subt	paras	mcta	tibφ	tib	mcti	ge1	ge2	ge3	mcg
<b>Leg I</b>												
Holotype	23	15	23	24	2.8	20	25	3.6	21	21	21	3.1
Minimum	18	14	21	13	2.5	19	22	3.0	17	18	20	2.9
Maximum	23	22	26	24	3.2	23	32	4.7	25	25	23	4.0
Mean	21	16	24	17	2.7	21	26	3.7	21	21	22	3.2
St. Dev.	1.2	2.1	1.3	3.1	0.2	1.2	2.4	1.1	2.0	1.8	1.1	0.3
<b>Leg II</b>												
Holotype	17	13			2.5	20	22		21			
Minimum	15	12			1.7	20	21		19			
Maximum	19	18			3.5	27	27		24			
Mean	17	13			2.7	22	23		21			
St. Dev.	0.9	1.6			0.5	1.8	1.5		1.6			
<b>Leg III</b>												
Holotype							27		21			
Minimum							22		19			
Maximum							28		24			
Mean							25		22			
St. Dev.							1.7		1.6			

**Abbreviations:** tar = tarsala; pret = pretarsala; subt = subterminala; paras = parasubterminala; mcta = microtarsala; tibφ = tibialaφ (solenidion); tib = tibiala; mcti = microtibiala; ge1 = genuala 1; ge2 = genuala 2; ge3 = genuala 3; mcg = microgenuala; Mtar = mastitarsala. (n = 16)

of PLs; PL > AL > AM (Table 1); scutal setae barbed similarly to dorsal setae; sensilla flagelliform with 7–8 long branches in distal half. Measurement of setae in table 1.

**LEGS** (Table 2): All 7-segmented, with the pair of claws and empodium. Leg I: 226, 233 (217–254) long; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 3 genualae, microgenuala; tibia 8B, 2 tibialae (1 solenidion), microtibiala; tarsus 18B, tarsala, microtarsala distal to tarsala, subterminala, parasubterminala with 1–2 small branches, pretarsala. Leg II: 196, 200 (189–205) long; coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, genuala; tibia 5B, 2 tibialae, microtibiala; tarsus 15B, tarsala, microtarsala proximal to tarsala, pretarsala. Leg III: 220, 226 (209–246) long; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, genuala; tibia 6B, tibiala; tarsus 15B.

Exemplars of three different idiosomal sizes were found. Idiosomal size is 162–663, but they are morphologically identical and distributed randomly in infected frogs.

**Type host:** *Pristimantis marcoreyesi* Reyes-Puig, Reyes-Puig, Ramirez-Jaramillo, Perez and Yáñez-Muñoz, 2014 (Amphibia: Anura: Craugastoridae).

**Type locality:** Vertientes Orientales del Volcán Tungurahua, Cantón Baños, Provincia de Tungurahua, Ecuador (1°26'17.15"S, 78°25'0.53"W), 2500 m (Fig. 6).

**Type material:** Holotype (AC-INB-0001), 10 paratypes (AC-INB-0002), and 6 paratypes (CP-MBUCV-6133), all from the same individual host. **LSID** urn:lsid:zoobank.org:act:FE09519E-B4F0-4BB1-AC66-CF9D3F238BCF

**Etymology:** The specific name refers to the zoogeographical region in which the host and parasites were found and described.

**Remarks:** The original diagnosis of *Vercammenia* by Audy and Nadchatram (1957) is: "larvae poorly sclerotized, with small (AW less than 50μ) pentagonal scutum and five scutal setae, filiform nude sensilla, slender chelicers with few dorsal notches or denticles, and seven barbed setae on palpal tarsus; leg I with greatly elongate tarsala and three genualae; leg III with genuala and tibiala . . ." and in the table of "Comparison of characters" point out "eyes: 2 + 2 inconspicuous, posterior eye unsclerotized rudimentary." "Cheliceral blade: 2 notch-like teeth" and "Palpal tarsus: 7B" and

in naked-eye characters: "chiggers in situ show them to be completely encysted immediately below the epidermis, with some flattening of epidermal cells."

Vercammen-Grandjean (1960), Domrow (1969), Domrow et al. (1983), and Domrow and Lester (1985) reviewed species in the genus and described some new species, showing the variability in the scutum and sensillae shape. The exemplars studied agree with description of the genus *Vercammenia*; six species have been assigned to it: *V. hendricksoni* Audy and Nadchatram, 1957 from Malaysia; *V. gloriosa* Domrow, 1969 and *V. zweifelorum* Domrow, Loomis and Lester, 1983, both from Australia; *V. pringlei* Vercammen-Grandjean and Langston, 1971 from South Africa; *V. lynni* (Ewing, 1942) from Jamaica; and *V. yorkeri* (Sambon, 1928) from Brasil. Domrow et al. (1983) don't recognize the species *V. pringlei* as belonging in the genus, and *V. lynni* and *V. yorkeri* are discussed below. The palpal formula (fPp), scutal ratio (PW/SD), and number of genualae I are: N.b.NBB.7B, 0.9, and 3 in *V. hendricksoni*; N.N.NNN.7B.S, 1.7, and 4 in *V. gloriosa*; b.b.bbB.7B.S, 1.3, and 3 in *V. zweifelorum*; and B.B.N.N.B.7B.S, 1.3, and 3 in *V. neotropica* n. sp. Our exemplars are closer to *V. zweifelorum*, but they differ in scutal shape, pentagonal deep (ratio PW/SD = 0.9), and sensilla flagelliform in latter but the posterior scutal margin broadly rounded, shallow (ratio PW/SD = 1.17–1.25) and sensillae with few distal branched in the former.

All the chiggers were collected encysted below the epidermis.

Reyes-Puig et al. (2010) in the description of the host as a new species of frog, reported 42% of the type series with subcutaneous pouches in the axial region but erroneously identified the mites as belonging to the family Epidermoptidae.

This is the first record of the genus *Vercammenia* in the neotropics.

### ***Microtrombicula ecuadorensis* n. sp.**

(Figs. 2, 3, 6; Tables 3, 4)

**Diagnosis:** SIF = 2N4B-N-2-3111.1000; fPp = B/B/BNB; Pc = 2; fCx = 1.1.1; fSt = 2.2; fSc = PL > AM > AL; fD = 2H-6-6-6-4-2; fV = 2-2-4-6-2u 4-2; DS = 26; VS = 18; NDV = 44; Ip = 665–751; H = (37–48);  $D_{\min}$  = (32–36);  $D_{\max}$  = (37–43);  $V_{\min}$  = (21–25);  $V_{\max}$  = (26–31); pa = (237–268); pm = (191–226); pp = (218–264).

**Description (larvae n = 16):** IDIOSOMA: 410, 463 (366–561) long and 251, 300 (212–398) wide. Eyes 1.0 the anterior in an elongated plate 23.4 (21.5–25.8) long. One pair of

humeral setae 48, 41 (37–48) long and slightly more slender and longer than other dorsal setae; 20 dorsal setae moderately barbed and decreasing in size posteriad; 4 sternal setae, anterior pair thinner than posterior pair and with few thin branches and 18 ventral setae longer posteriad; total number of idiosomal setae, excluding coxalae, 48.

GNATHOSOMA: 45, 51 (44–59) long. Blade of chelicera with tricuspid cap bilobed at the base; gnathobase with single pair of 4 branched setae; galeala nude; palpal claw deeply bifurcate, with one ventral and one dorsal prong; setae on palpal femur and genu with 3–4 branches; dorsal and ventral tibial setae branched and lateral tibial seta nude; palpal tarsus with 1 nude and 1 nearly nude (sometimes with 1 branch), 4 branched setae, and tarsala.

SCUTUM: Subpentagonal, rounded posterior margin, and with puncta randomly distributed; AM base very anterior to ALs; PL > AM > AL (Table 3); scutal setae barbed similarly to dorsal setae; sensillae flagelliform with 8–10 branches in distal half only in a side.

LEGS (Table 4): All 7-segmented, with the pair of claws and empodium. Leg I: 268, 255 (237–268) long; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 3 genualae, microgenuala; tibia 8B, 2 tibialae (1 is a solenidion,  $\phi$ ), microtibiala; tarsus 22B, tarsala, microtarsala distal to tarsala, subterminala, thin and small parasubterminala, pretarsala. Leg II: 226, 214 (191–226) long; coxa 1N; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, genuala; tibia 6B, 2 tibialae; tarsus 16B, tarsala, microtarsala proximal to tarsala, pretarsala. Leg III: 226, 246 (218–264); coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, genuala; tibia 8B, tibiala; tarsus 13B, mastitarsala, nude or with 1 short branch.

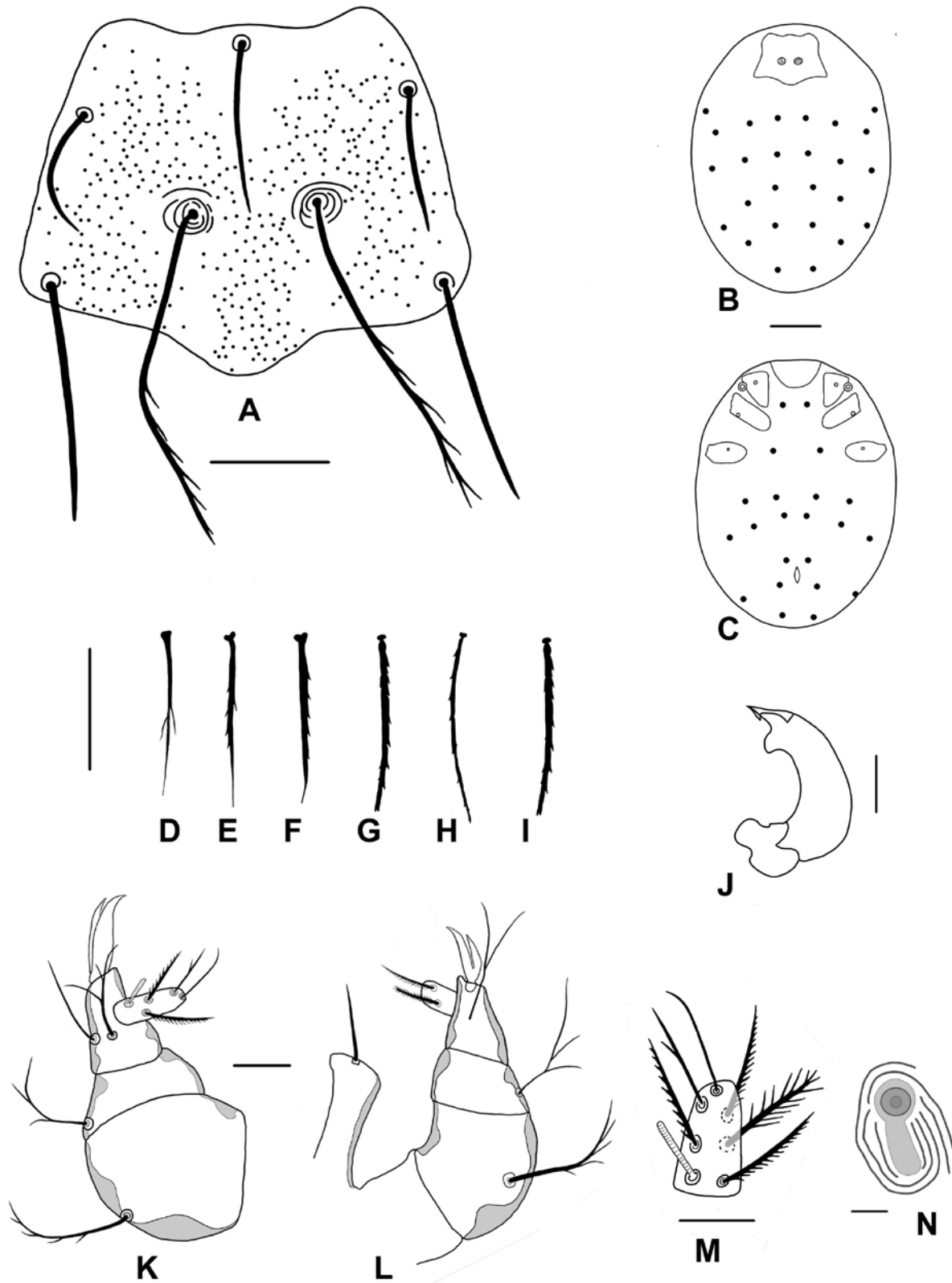
**Type host:** *Pristimantis* aff. *bellator* after Yáñez-Muñoz et al., 2013 (Amphibia: Anura: Craugastoridae).

**Type locality:** Reserva Biológica Tapichalaca, Zamora Chinchipe, Ecuador (4°49'S, 79°08'W), 2729 m (Fig. 6).

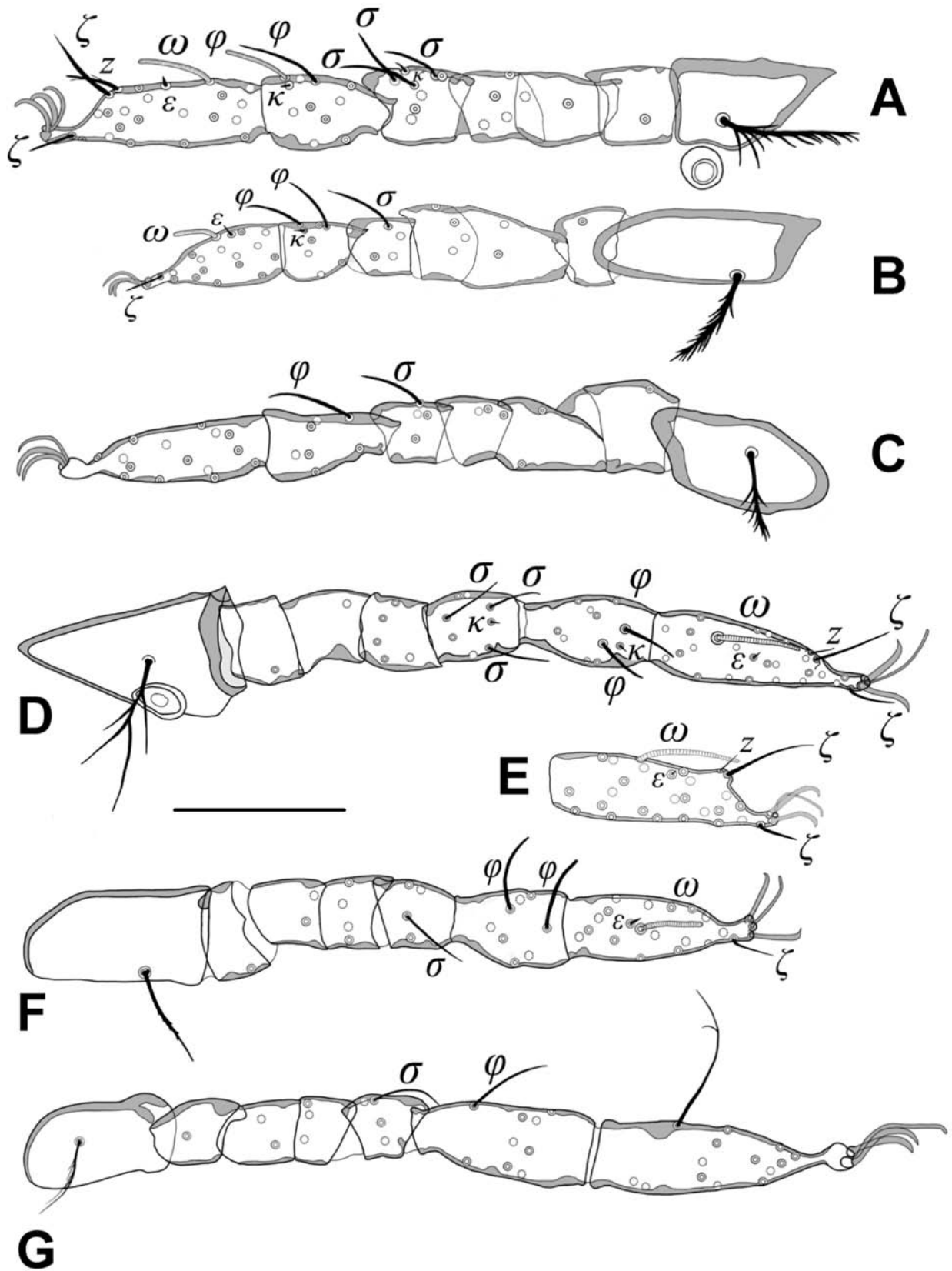
**Type material:** Holotype (AC-INB-0003), 9 paratypes (AC-INB-0004), and 6 paratypes (CP-MBUCV-6135) all from same individual host. **LSID** urn:lsid:zoobank.org:act:7E978016-9A7D-4FFE-B71E-A53285FB294D

**Etymology:** The specific name refers to the country of geographical origin, Ecuador.

**Remarks:** The exemplars belong to the genus *Microtrombicula* Ewing, 1950, and their characters agree with the definition in Webb and Loomis, 1970 as follows: "scutum subpentagonal, with 5 setae (1 AM seta) and without anteromedial projection; sensilla flagelliform nude or with few to many distal branches, or slightly expanded, ...



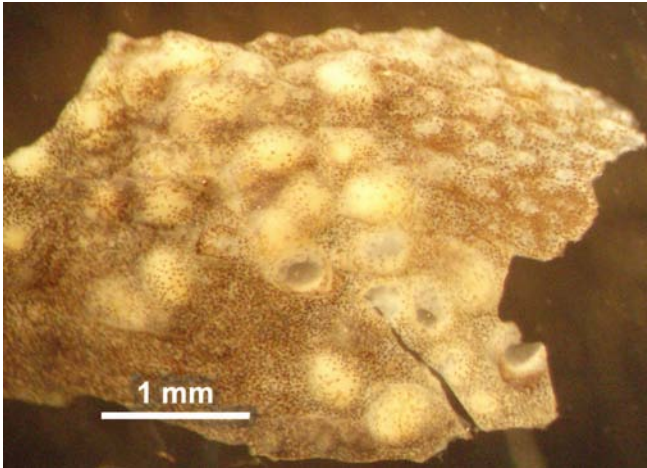
**Figure 2.** *Microtrombicula ecuadorensis* n. sp. A, scutum; B, arrangement of dorsal idiosomal setae; C, arrangement of ventral idiosomal setae; D, anterior sternal seta; E, posterior sternal seta; F, anterior idiosomal seta; G, posterior idiosomal seta; H, humeral seta; I, dorsal idiosomal seta; J, cheliceral blade; K, gnathosoma, ventral view; L, gnathosoma, dorsal view; M, palpal tarsus in ventral view; N, eye. Scale bars: J, K, L, M, N = 10 µm; A, D, E, F, G, H, I = 25 µm; B, C = 100 µm.



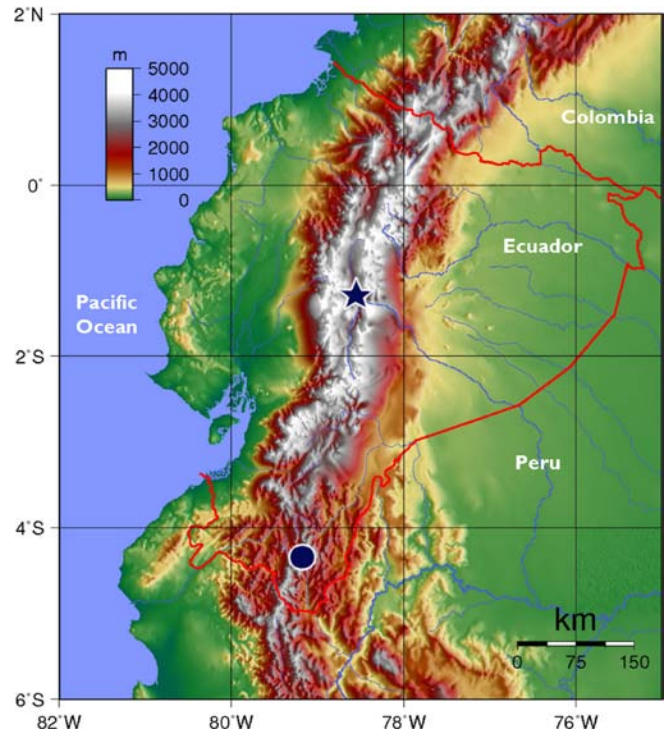
**Figure 3.** *Vercammenia neotropica* n. sp. A, Leg I; B, Leg II; C, Leg III. *Microtrombicula ecuadorensis* n. sp. D, Leg I; E, Tarsus I; F, Leg II; G, Leg III. Scale bar = 50 μm.



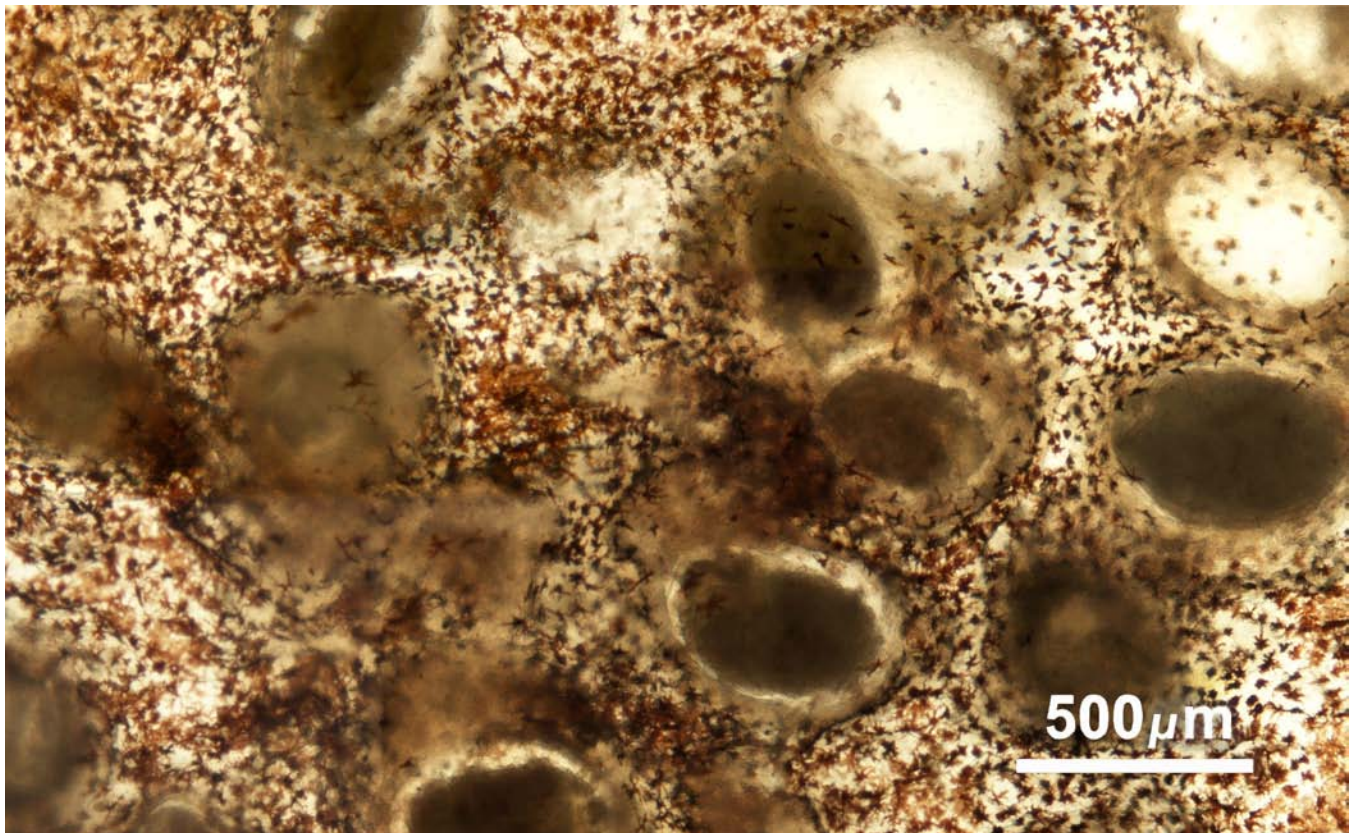
palpotarsus with 6 branched and nude setae, tarsala and without subterminala; palpotibial claw trifurcate or bifurcate, cheliceral blade with tricuspid cap; 2–3 pairs of sternal setae; leg I with coxa unisetose . . . leg II with coxa usually unisetosa (rarely 2 setae) . . . , leg III with coxa having 1–8 branched setae.” Vercammen-Grandjean (1960) proposed the subgenus *Scapuscutala* for species of *Microtrombicula*



**Figure 4.** Skin of *Pristimantis marcoreyesi* showing nodules with *Vercammenia neotropica* n. sp.



**Figure 6.** Map of distribution of the two new species. Star, type locality of *Vercammenia neotropica* n. sp.; circle, type locality of *Microtrombicula ecuadorensis* n. sp.



**Figure 5.** Microscopical view of exemplars of *Vercammenia neotropica* inside the skin of host.

with a nonreticulate scutum and branched sensilla with *Trombicula crossleyi* Loomis 1954 as the type species, later the same author (Vercammen-Grandjean, 1965) included 12 species with palpal claw bifurcate and 3 genualae I. Webb and Loomis (1971) in their diagnosis of *Scapuscutala* included the American species that are characterized by the following: "having pretarsala II, 3 genualae I, 3 pairs of sternal setae and/or coxa III multiple setae, palpal claw bifurcate, PL ≥ AL, scutum with small scattered puncta,

and sensillae flagelliform with basal barbs and 8–16 distal branches." Hoffmann (1990) points out that these characters are variable among species, and she does not accept the subgenus designation; here, we follow her point of view but refer to "*Scapuscutala*" as a species group with 6B or 6B&N on palpal tarsus, palpal claw bifurcate, 3 genualae I, scutum with puncta and sensilla with 8–16 distal branched as the exemplars described here. The species with these characters are: *Microtrombicula crossleyi* (Loomis, 1954), *M.*

**Table 3.** *Microtrombicula ecuadorensis* n. sp. measurements of scutal setae of the type-series

	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	S
Holotype	56	66	21	29	27	56	26	30	29	42	61
Minimum	47	60	18	29	26	56	26	29	26	39	50
Maximum	63	74	24	37	32	70	32	34	30	45	61
Mean	54	65	20	32	28	60	28	32	28	42	58
St. Dev.	3.5	3.5	1.6	2.7	1.7	4.2	1.6	1.7	1.3	1.8	4.0

**Abbreviations:** AW = distance between ALs; PW = distance between PLs; SB = distance between sensillary bases; ASB = distance from level of sensillary bases to extreme anterior margin of scutum; PSB = distance from level of sensillary bases to extreme posterior margin of scutum; SD = length of scutum (ASB + PSB); AP = distance from AL to PL on one side; AM = length of tanteromedian setae; AL = length of anterolateral setae; PL = length of posterolateral setae; S = length of sensilla. (n = 17)

**Table 4.** *Microtrombicula ecuadorensis* n. sp. measurements of the modified setae of legs in the type-series

	Tarsus					Tibia			Genu			
	tar	pret	subt	paras	mcta	tibφ	tib	mcti	ge1	ge2	ge3	mcg
<b>Leg I</b>												
Holotype	34	13	26	7.5	4.2	20	22	4.3	21	23	23	3.3
Minimum	31	11	226	5.3	2.9	17	20	2.8	17	19	21	2.6
Maximum	36	14	30	9.8	4.2	21	25	4.6	24	24	24	4.1
Mean	34	13	28	7.0	3.4	19	23	3.7	21	22	22.	3.3
St. Dev.	1.4	0.9	1.3	1.2	0.3	1.1	1.3	0.5	1.9	1.5	1.1	0.6
<b>Leg II</b>												
Holotype	18	12			2.8	20	20		23			
Minimum	17	9.4			2.4	16	16		18			
Maximum	20	14			4.3	21	23		23			
Mean	18	12			3.2	19	20		21			
St. Dev.	0.9	1.5			1.5	1.4	1.7		1.9			
<b>Leg III</b>												
	Mtar											
Holotype	39						21		23			
Minimum	31						19		20			
Maximum	42						23		24			
Mean	37						21		22			
St. Dev.	3.1						1.0		1.2			

**Abbreviations:** tar = tarsala; pret = pretarsala; subt = subterminala; paras = parasubterminala; mcta = microtarsala; tibφ = tibialaφ (solenidion); tib = tibiala; mcti = microtibiala; ge1 = genuala 1; ge2 = genuala 2; ge3 = genuala 3; mcg = microgenuala; Mtar = mastitarsala. (n = 16)

*rhoptropi* (Lawrence, 1949), *M. trisetica* (Loomis and Crossley, 1953), *M. maura* (Tauflied, 1960), *M. meridialis* (Tauflied, 1960), *M. nadchatrami* Vercammen-Grandjean, 1965, *M. nicaraguae* Webb and Loomis, 1970, *M. paralius* Webb and Loomis, 1970, *M. aequalis* Webb and Loomis, 1971, *M. fisheri* Webb and Loomis, 1971, *M. intermedia* Webb and Loomis, 1971, and *M. mesoamericana* Webb and Loomis, 1971. *Microtrombicula trisetica*, *M. aequalis*, *M. crossley*, *M. fisheri*, and *M. intermedia* have coxa III multisetose, the fCx in *M. ecuadorensis* n. sp. is 1-1-1; in *M. maura*, *M. meridialis*, and *M. mesoamericana* there are 6 sternal setae, in *M. ecuadorensis* only 4; *M. nadchatrami*, *M. paralius*, and *M. nicaraguae* have NDV = 70–72, but *M. ecuadorensis* has fewer setae (NDV = 44), thus *M. rhoptropi* is the more similar, but in this species the palpal tarsus is 6B, fPp B/N/N.N.N and fCx B.B.B, in *M. ecuadorensis* 2N4B, fPp B/B/BNB, and fCx B.N.B, respectively.

A total of 19 specimens of *Pristimantis* aff. *bellator* from the Tapichalaca biological reserve were collected in the years 2003, 2008, and 2012; 32% (6) of the specimens examined of these terrestrial frogs were infected in 2008 and 2012, *Microtrombicula ecuadorensis* was found in two red cavities under the skin on each side of the axial region and flanks. All terrestrial frogs that were found infected were collected on the ground among moss or leaf litter.

## Discussion

Species that can be allocated to 3 genera have been described from subcutaneous tissues in anurans; these are: *Hannemania* Oudemans, 1911 in the New World and New Caledonia; *Endotrombicula* Ewing, 1931 in Africa; and *Vercammenia* Audy and Nadchatram, 1957 in Southeast Asia and Australia. In the western hemisphere, 25 species of *Hannemania* have been reported (Wohltmann et al. 2006, Silva de la Fuente et al., 2016), and two other species are of uncertain status, *Trombicula yorkei* Sambon, 1928 in Brazil and *Schoengastia lynni* Ewing, 1942 in Jamaica. *T. yorkei* was described by Sambon (1928) with “found in tiny whitish cyst on the inter-digital web of the feet of *Hyla rubra*” and characterized by the “shape of the dorsal shield,” but the species was very incompletely described. Later Domrow (1969) in his review of *Vercammenia* redescribed the species on the basis of the holotype and three topotypes and renamed it *Vercammenia yorkei* (Sambon, 1928), but he does not provide justification to place these exemplars in the genus *Vercammenia*; in his description the species has a palpal tarsus 6B, palpal claw with two prongs, eyes 1 + 1, and in figure 17 a mastitarsala is very clear in leg III as well as in the pretarsala II—in fact, all these characters

are present in *Microtrombicula*. Therefore, *T. yorkei* must be transferred to this genus as *Microtrombicula yorkei* (Sambon, 1928) n. comb.

*Schoengastia lynni* Ewing, 1942 was also briefly described from exemplars without sensilla. Wharton and Fuller (1952) proposed a new combination as *Endotrombicula lynni* without any comment, but the original description is poor with no mention of them being endoparasitic. Therefore, Domrow (1969) excluded this species from consideration, and he agreed with Wohltmann et al. (2007). However, the types are lost, and we feel that this species should be considered *incertae sedis* until more material can be collected.

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