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A NEW DWARF SPECIES, NEW DISTRIBUTION RECORDS, AND SUPPLEMENTARY DESCRIPTIVE NOTES OF THE CENTIPEDE GENUS *ITYPHILUS* COOK, 1899 (CHILOPODA: GEOPHILOMORPHA: BALLOPHILIDAE) FROM CENTRAL AMAZONIA, BRAZIL

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ABSTRACT

A new dwarf species of the centipede genus *Ityphilus* *Cook, 1899, named* *I. donatellae* *sp. nov.* (Chilopoda: Geophilomorpha: Ballophilidae) is hereby proposed on the basis of specimens from the vicinity of Manaus, Central Amazonia (Brazil), previously identified as *Ityphilus calinus* Chamberlin, 1957 (hereby designated holotype female, paratype male and paratype female). Supplementary morphological data and new illustrations are provided after this type material. The new species, characterized by having the internal edge of the forcipular tarsungulum serrate, is herein included in a key that will enable the identification of the 10 other Neotropical members of the genus *Ityphilus* sharing the same trait. New distribution records and supplementary descriptive notes for *Ityphilus crabilli* Pereira, Minelli & Barbieri, 1994, and *Ityphilus demoraisi* Pereira, Minelli & Barbieri, 1995 (including the first description of the male of the latter), are also given. Undiluted 2-Phenoxyethanol (CAS No. 122-99-6) has been used as an effective clearing agent/mounting medium for the preparation of temporary mounts of all body parts of the examined specimens.

KEY-WORDS: *Ityphilus*; Taxonomy; New species; New distribution records; Central Amazonia; Brazil; Geophilomorpha; Ballophilidae.

INTRODUCTION

In a former contribution to taxonomy of Neotropical geophilomorphs (Pereira *et al.*, 2000), a few tiny ballophilid specimens collected near Manaus, Central Amazon (Brazil), were assigned to *Ityphilus calinus* Chamberlin, 1957, whose type locality is in Colombia: 13 miles West of Santiago de Cali (Southern region of the Cauca River Valley). A redescription of the taxon was also given (based on

those specimens), but stating that the identification was provisional since they could belong to a new species. On the basis of current criteria for species discrimination within the genus *Ityphilus*, it may be concluded in the present contribution that the data given by Chamberlin in his original description of *I. calinus* (including the traits that can be deduced from the single accompanying figure), although very scarce, are important enough to confidently consider the mentioned material from Brazil as belonging to a

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different species (and new to science), which is herein proposed under the name of *Ityphilus donatellae*.

A chance to examine additional ballophilid specimens from Central Amazonia (currently deposited at the Museo de La Plata, but never cited in previous publications), permits the addition of new distribution records and supplementary descriptive notes for *Ityphilus crabilli* Pereira, Minelli & Barbieri, 1994, and *Ityphilus demoraisi* Pereira, Minelli & Barbieri, 1995 (including the first description of the male of the latter).

The genus *Ityphilus* Cook, 1899, can be distinguished from the other genera recognized in the family Ballophilidae by the following combination of features: (1) antennae somewhat curved at middle to truly geniculate, distally slightly thickened to strongly clavate; (2) mid-piece of labrum membranous, without teeth or with minute hair-like structures; (3) forcipular coxosternite with incomplete to nearly complete chitin-lines; (4) internal edge of forcipular tarsungulum smooth or serrate; (5) ventral pore-fields of anterior region of the body single (subcircular to transversally elliptical in shape), those of posterior region, single or divided into two areas; (6) coxopleura of the ultimate leg-bearing segment each with two internal coxal organs of simple structure ("homogeneous coxal glands", *sensu* Brölemann & Ribaut (1912)); (7) legs of the ultimate pair with seven articles; (8) ultimate pretarsus setiform, basally tubercle-like and usually accompanied by a minute spine.

Of the twenty three species currently assigned to *Ityphilus*, the vast majority of them (eighteen, in addition to the new species proposed herein) occur in the Neotropics; the key below, will enable the identification of those Neotropical members having the internal edge of the forcipular tarsungulum serrate (including *I. donatellae* sp. nov., which shares this trait).

MATERIAL AND METHODS

The new material herein reported is currently deposited at the Museo de La Plata (MLP); the type materials herein designated and examined are housed at the Instituto Nacional de Pesquisas da Amazônia (INPA), and the MLP, as indicated under each species.

The specimens were dissected through a stereomicroscope, examined, and illustrated in detail using a compound microscope equipped with a drawing tube attachment (the latter was used to delineate the figures and also measured directly in mm

with an objective micrometer). Temporary mounts were prepared by direct transfer of the specimens from the preservation liquid (70 per cent ethanol) onto microscope slides. The clearing agent/mounting medium used was undiluted 2-Phenoxyethanol (CAS No. 122-99-6). No additional steps were carried out before mounting. (The slides were temporarily stored in hermetic acrylic boxes to avoid evaporation of this fluid). Details of the preparation of microscope slides and dissection procedures are described in Pereira (2000), Foddai *et al.* (2002). All measurements are given in mm. Terminology for external anatomy follows Bonato *et al.* (2010). The following abbreviation was used in the text and legends of the figures: a.a. - antennal article/articles.

RESULTS

Family Ballophilidae

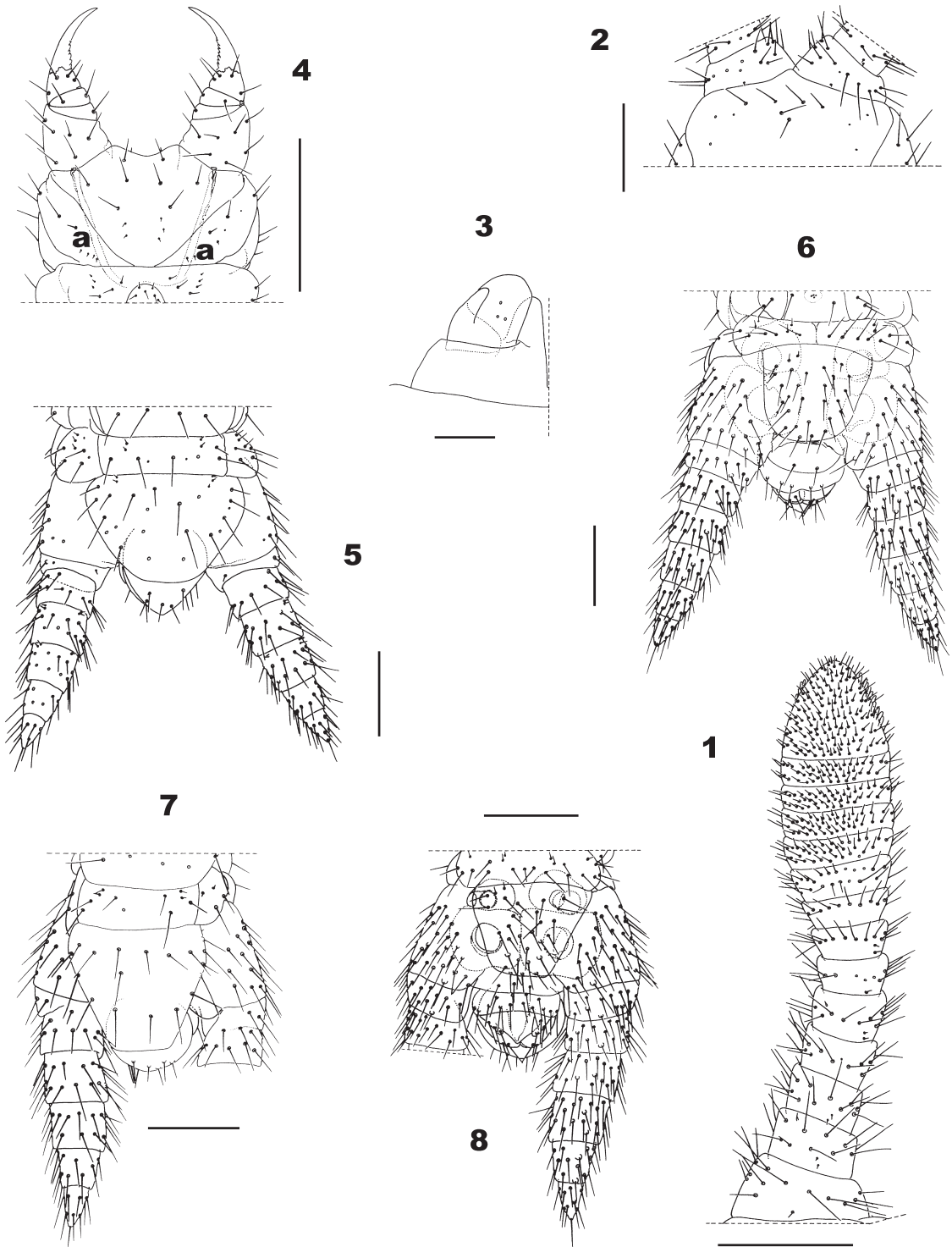
Genus *Ityphilus* Cook, 1899

Type species of the genus: Ityphilus lilacinus Cook, 1899, by original designation.

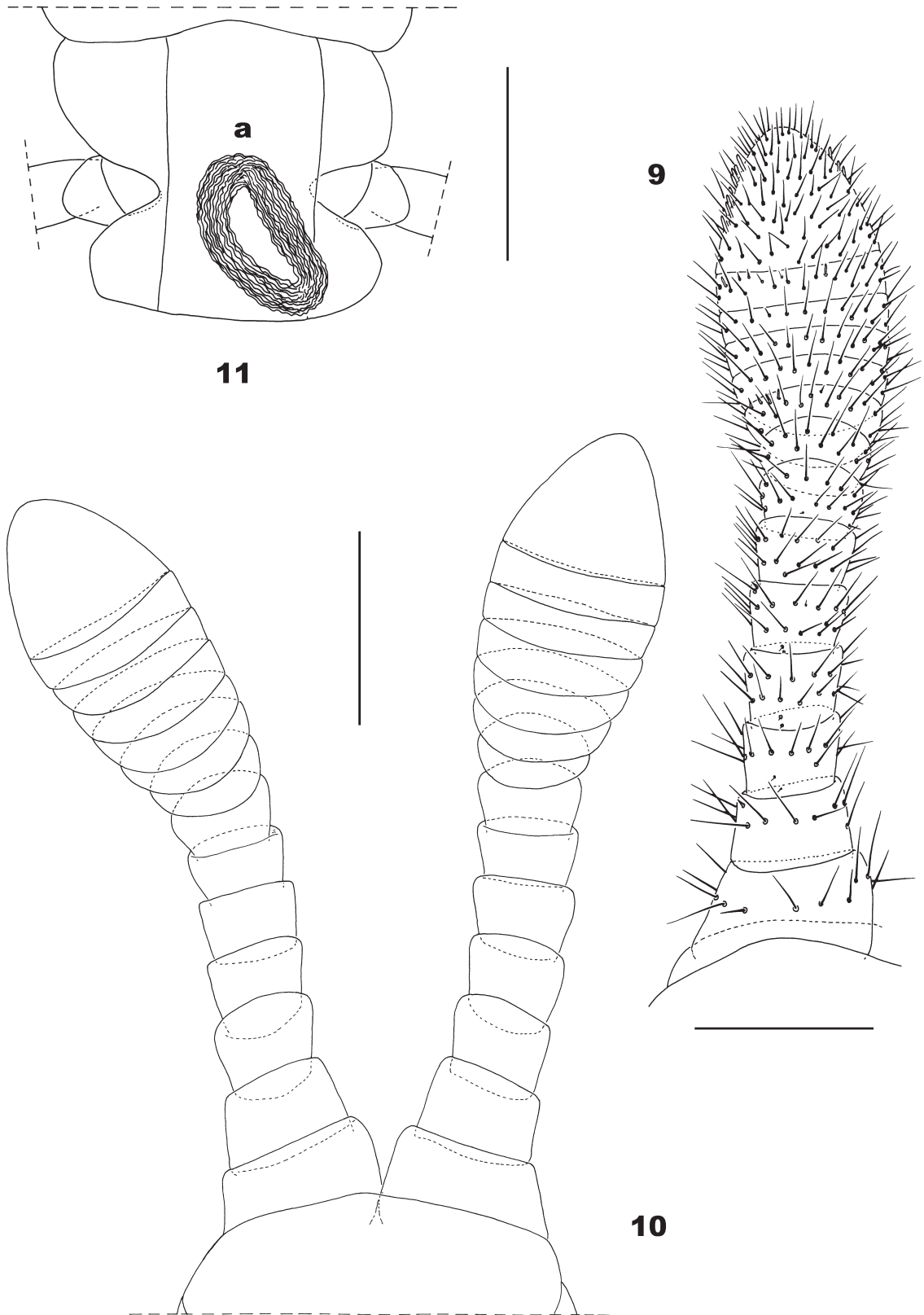
Neotropical species currently included in the genus: I. betshi Pereira, 2010 (French Guiana); *I. calinus* Chamberlin, 1957 (Colombia); *I. cavernicolus* (Matic, Negrea & Fundora Martinez, 1977) (Cuba); *I. ceibanus* Chamberlin, 1922 (Honduras); *I. crabilli* Pereira, Minelli & Barbieri, 1994 (Brazil); *I. demoraisi* Pereira, Minelli & Barbieri, 1995 (Brazil); *I. grandis* (Turk, 1955) (Peru); *I. guianensis* Chamberlin, 1921 (Guyana, Trinidad, Brazil); *I. idanus* Crabill, 1960 (British West Indies: Barbuda); *I. krausi* Pereira & Minelli, 1996 (Peru); *I. lilacinus* Cook, 1899 (Bahama Islands: South Bimini, Cuba, Puerto Rico, USA); *I. mauriesi* Demange & Pereira, 1985 (French Antilles: Guadeloupe); *I. palidus* (Matic, Negrea & Fundora Martinez, 1977) (Cuba); *I. perrieri* (Brölemann, 1909) (Brazil); *I. polypus* (Matic, Negrea & Fundora Martinez, 1977) (Cuba); *I. saucius* Pereira, Foddai & Minelli, 2000 (Brazil); *I. savannus* Chamberlin, 1943 (Mexico); *I. sensibilis* Pereira, Foddai & Minelli, 2000 (Brazil).

Ityphilus donatellae sp. nov. (Figs. 1-14)

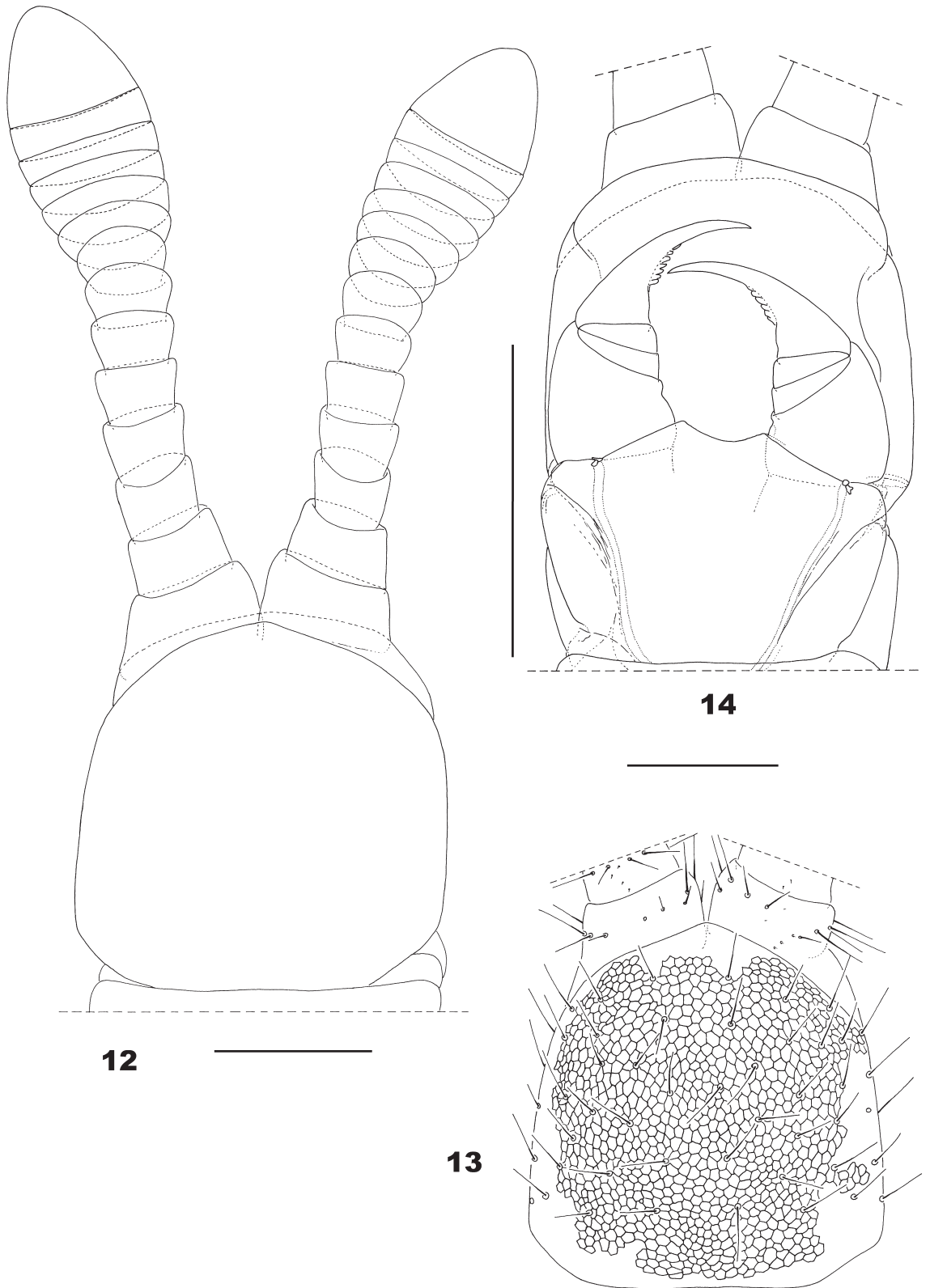
Ityphilus calinus: Pereira, Foddai & Minelli, 2000:1, 6-8 (non *Ityphilus calinus* Chamberlin, 1957).



FIGURES 1-8: (1-6): *Itypbilus donatellae* sp. nov., (female holotype; Brazil: Amazonas: 02°34'S, 60°06'W): (1) Left antenna, ventral; (2) Clypeus and bases of antennae; (3) Left side of first maxillae, dorsal; (4) Forcipular segment, ventral (a: chitin-lines); (5) Ultimate leg-bearing segment and postpedal segments, dorsal; (6) Ultimate leg-bearing segment and postpedal segments, ventral. (From Pereira *et al.*, 2000). (7-8): *Itypbilus donatellae* sp. nov., (male paratype; Brazil: Amazonas: 02°34'S, 60°06'W): (7) Ultimate leg-bearing segment and postpedal segments, dorsal; (8) Ultimate leg-bearing segment and postpedal segments, ventral. (From Pereira *et al.*, 2000). Scale bars: 0.03 mm (3); 0.1 mm (1, 2, 5-8); 0.2 mm (4).



FIGURES 9-11: *Ityphilus donatellae* sp. nov., (female paratype; Brazil: Amazonas: 02°34'S, 60°06'W): (9) Left antenna, dorsal; (10) Contour of antennae, ventral; (11) posterior spermatheca at level of leg-bearing segment 39, ventral (a: spermatheca). Scale bar: 0.1 mm (9-11).



FIGURES 12-14: *Ityphilus donatellae* sp. nov., (female paratype; Brazil: Amazonas: 02°34'S, 60°06'W): **(12)** Contour of antennae and cephalic plate; **(13)** Chaetotaxy and detail of areolation of cephalic plate; **(14)** Forcipular segment, cephalic capsule and bases of antennae, ventral (mouthparts and setae, suppressed). Scale bars: 0.1 mm (12, 13); 0.2 mm (14).

Diagnosis: An *Ityphilus* species with internal edge of forcipular tarsungulum partially serrate, very small body size (8.5 to 11 mm), and low number of leg-bearing segments (41 or 43). Among the other Neotropical members of the genus, it only shares the last trait with *Ityphilus calinus* Chamberlin, 1957. *Ityphilus donatellae* sp. nov. can be principally differentiated from *I. calinus* on the basis of the following selected traits (those for the latter are given in parentheses): antennae curved at middle, truly geniculate, Figs. 1, 9, 10, 12 (“curved at middle but not truly geniculate”, Fig. 26); antennae distally strongly clavate, Figs. 1, 9, 10, 12 (antennae distally slightly thickened, Fig. 26); a.a. XIV wider than long, in the proportion ca. 0.93: 1, Figs. 1, 9, 10, 12 (a.a. XIV longer than wide in the proportion ca. 1.49: 1, Fig. 26). Other traits differentiating both species, as in Table 1.

Remarks: The differential characters listed in the previous lines and Table 1 (especially those related to the antennae) are stable enough in ballophilids, thus giving confidence in considering the specimens assigned to *Ityphilus calinus* in Pereira *et al.* (2000), as belonging to a species different to it, and new for the genus.

Among the Neotropical species of *Ityphilus*, *I. crabilli* Pereira, Minelli & Barbieri, 1994 and *I. guianensis* Chamberlin, 1921 (both with forcipular tarsungulum serrate) share with *I. donatellae* a roughly similar range of leg-bearing segments. *I. calinus* Chamberlin, 1957 and *I. savannus* Chamberlin, 1943 (of which it is unknown whether the forcipular tarsungulum is serrate or smooth) also share a similar range. *Ityphilus donatellae* can be separated from *I. calinus* as shown in Table 1. It can be confidently differentiated from the other three taxa, by means of the following selected traits (the corresponding features for the new species are given in parentheses):

- *I. crabilli*: male with 47, female with 47, 49, 51, 53 leg-bearing segments; body length 15 mm for males, 21 mm for females; antennae apically moderately clavate; specialized sensilla on apex of a.a. XIV with two very small apical branches; coxosternite of first maxillae with lappets; chitin-lines of forcipular coxosternite incomplete. (Male with 41, female with 43 leg-bearing segments; body length 8.5 mm in the male, 11 mm in females; antennae apically strongly clavate, Figs. 1, 9, 10, 12; specialized sensilla on apex of

TABLE 1: Comparative matrix of morphological traits for *Ityphilus donatellae* sp. nov. and *Ityphilus calinus* Chamberlin, 1957. (Data of *I. donatellae* taken from holotype female, paratype male and paratype female; data of *I. calinus* taken from the original description (based on the holotype male)).

	<i>I. donatellae</i> sp. nov.	<i>I. calinus</i> Chamberlin, 1957
Number of leg-bearing segments	41 (male) 43 (female)	43 (male)
Body length	8.5 mm (male) 11 mm (female)	19 mm (male)
Shape of the antennae	Curved at middle, truly geniculate (Figs. 1, 9, 10, 12)	“Curved at middle but not truly geniculate” (Fig. 26)
Antennae distally strongly clavate	Yes (Figs. 1, 9, 10, 12)	No, slightly thickened, “moderately clavate beyond middle” (Fig. 26)
Antennae contiguous at base	Yes (Figs. 2, 10, 12)	No (Fig. 26)
Ratio of width of widest article of distal antennal half/width of narrowest article of proximal antennal half	ca. 1.58: 1 (a.a. XI/a.a. VI)	ca. 1.21: 1 (a.a. XI/a.a. VI)
Ratio of length/width of a.a. XIV	ca. 0.93: 1 (wider than long)	ca. 1.49: 1 (longer than wide)
Ratio of length of a.a. XIV/length of a.a. XIII	ca. 4.0: 1	ca. 2.61: 1
Ratio of length of a.a. XIV/length of a.a. XI to XIII taken together	ca. 1.25: 1	ca. 0.94: 1
Shape of cephalic plate	Lateral margins slightly converging anteriad (Figs. 12, 13)	Lateral margins slightly convex (Fig. 26)
Length/width ratio of cephalic plate	ca. as long as wide	ca. 1.23: 1 (longer than wide)
Forcipular telopodites	Tarsungula when closed wholly behind the anterior margin of the head (Fig. 14)	“Claws of prehensors when closed extending a little beyond anterior margin of head”
Forcipular tarsungulum serrate	Yes	?
Tergites	Sulci not evident (apparently absent)	“Dorsal plates bisulcate”

a.a. XIV not split apically; coxosternite of first maxillae without lappets, Fig. 3; chitin-lines of forcipular coxosternite complete, Fig. 4: a).

- *I. guianensis*: clypeus with *ca.* six setae; sternite of leg-bearing segment 1 with pore-field; 49, 55 leg-bearing segments; body length 23 mm; chitin-lines of forcipular coxosternite incomplete. (Clypeus with *ca.* 12 setae; sternite of leg-bearing segment 1 without pore-field; (other features, already mentioned above)).
- *I. savannus*: pore-fields present from sternite of leg-bearing segment 2 to fourth sternite from rear end of the body; 55 leg-bearing segments; body length 16 mm. (Ventral pore-fields present from second to penultimate leg-bearing segment; (other features, already mentioned above)).

Ityphilus donatellae sp. nov. can be separated from the other Neotropical species of *Ityphilus* characterized by having the forcipular tarsungulum serrate, by using the key below.

Type material (hereby designated): BRAZIL: Amazonas: secondary upland forest (02°34'S, 60°06'W), M.O. de A. Ribeiro leg., 7 November 1990: holotype female, 43 leg-bearing segments, body length 11 mm (INPA); same locality and collector, 6 December 1990: paratype male, 41 leg-bearing segments, body length 8.5 mm (INPA); same locality and collector, 9 October 1990: paratype female, 43 leg-bearing segments, body length 11 mm (MLP).

Remarks: For details of morphological characters of *I. donatellae* sp. nov., see the "Redescription" of "*Ityphilus calinus* Chamberlin, 1957" given in Pereira *et al.* (2000:6-8, figs. 42-68), in which the present holotype female (cited as Specimen "A") and paratype male (cited as Specimen "B") are described and illustrated in detail. Nevertheless, the following complementary morphological data can be added here based on the original figures of those specimens. Supplementary precisions on external morphology (together with new illustrations) are incorporated from the paratype female (examined here).

Additional morphological information:

Holotype female: Antennae nearly contiguous at base (Fig. 2), curved at middle and truly geniculate, apically distinctly thickened, strongly clavate (Fig. 1). Ratio of width of a.a. XI (= widest antennomere of

distal antennal half)/width of a.a. VI (= narrowest antennomere of basal antennal half), *ca.* 1.58: 1; ratio of length of a.a. XIV/length of a.a. XI to XIII taken together, *ca.* 1.25: 1; ratio length of a.a. XIV/length of a.a. XIII, *ca.* 4.0: 1. Length/width ratio of left a.a. I to XIV as follows: I (0.50: 1); II (0.60: 1); III (0.60: 1); IV (0.60: 1); V (0.66: 1); VI (0.48: 1); VII (0.44: 1); VIII (0.36: 1); IX (0.33: 1); X (0.27: 1); XI (0.25: 1); XII (0.22: 1); XIII (0.24: 1); XIV (0.93: 1).

Forcipular segment (Fig. 4): forcipular coxosternite with maximum width/length at the middle ratio, *ca.* 1.70: 1; forcipular telopodite with ratio of maximum length/maximum width of trochanteroprefemur, *ca.* 1.06: 1.

Ultimate leg-bearing segment (Figs. 5, 6): wider than the penultimate leg-bearing segment in the proportion, *ca.* 1.16: 1; length/width ratio of tergite 0.68: 1; length/width ratio of sternite, 0.85: 1. Ultimate legs: ratio length of telopodites/length of sternite *ca.* 2.02: 1; ratio width of trochanter/width of tarsus 2, *ca.* 3.4: 1.

Paratype male: Ultimate leg-bearing segment (Figs. 7, 8): wider than the penultimate leg-bearing segment in the proportion, *ca.* 1.35: 1; length/width ratio of tergite 0.88: 1; length/width ratio of sternite, 0.81: 1. Ultimate legs: ratio length of telopodites/length of sternite, *ca.* 2.43: 1; ratio width of trochanter/width of tarsus 2, *ca.* 3.0: 1.

Paratype female: Antennae: dorsal chaetotaxy of a.a. I-VIII represented by setae of different lengths, few in number and similar to those on the ventral side, setae on a.a. IX-XIV larger and much less numerous than those on ventral side (Fig. 9). Contour of appendages as in Figs. 10, 12.

Cephalic plate: surface with reticulation as in Fig. 13; ratio of maximum width of cephalic plate/maximum width of forcipular tergite, *ca.* 1.05: 1.

Forcipular segment: forcipular tergite a little wider than the tergite of the first leg-bearing segment (in the proportion *ca.* 1.04: 1). Tarsungula when closed wholly behind the anterior margin of the head (Fig. 14).

Tergites of leg-bearing segments: sulci not evident (apparently absent). Spermathecae (full of spermatozoa) located at level of the leg-bearing segments 38, 39, shape of posterior spermatheca as in Fig. 11: a.

Etymology: This species is dedicated to Dr. Donatella Foddai (Padova, Italy), who was a kind partner in previous studies on geophilomorph centipedes.

Type locality: BRAZIL: Amazonas: secondary upland forest (02°34'S, 60°06'W).

Known range: BRAZIL: Amazonas: secondary upland forest (02°34'S, 60°06'W); Adolpho Ducke Forest Reserve (02°55'S, 59°59'W).

***Ityphilus crabilli* Pereira, Minelli & Barbieri, 1994 (Figs. 15-17)**

Ityphilus crabilli Pereira, Minelli & Barbieri, 1994:163, 164-166; Pereira *et al.*, 1995:326, 327; Adis *et al.*, 1996:168, 169; Pereira & Minelli, 1996:110; Foddai *et al.*, 2000:153; 2002:473; 2004:276; Bonato *et al.*, 2007:3; Pereira, 2010:659-660.

Type material examined: Holotype female, with 53 leg-bearing segments, body length 21 mm, from BRAZIL: Amazonas: Rio Tarumã Mirim, Igapó (BE), 4 August 1976, J. Adis legit. (INPA).

New material examined: BRAZIL: Amazonas: Manaus: INPA (secondary upland forest, unburned), Kempson soil extraction, 25 September 1985, J. Adis *et al.* leg.: 1 female (with the two spermathecae full of spermatozoa), 49 leg-bearing segments, body length 23 mm; 1 male with 47 leg-bearing segments, body length 15 mm (MLP). BRAZIL: Amazonas: secondary upland forest (02°34'S, 60°06'W), 3 January 1991, M.O. de A. Ribeiro leg.: 1 male (with tubula seminifera full of mature spermatozoa), 47 leg-bearing segments, body length 16 mm (MLP). Same locality and collector, 6 October 1990: 1 female (with the two spermathecae full of spermatozoa, and with mature ova), 49 leg-bearing segments, body length 22 mm; 6 December 1990: 1 male (with tubula seminifera full of mature spermatozoa), 47 leg-bearing segments, body length 15 mm; 7 November 1990: 1 female (with the two spermathecae full of spermatozoa), 49 leg-bearing segments, body length 16 mm; 1 juvenile (female?) with 1+1 coxal organs only, 49 leg-bearing segments, body length 7 mm (MLP). BRAZIL: Amazonas: Lago Janauari, secondary upland forest (03°20'S, 60°17'W), pitfall traps, 29 December 1995, J. Adis *et al.* leg.: 1 female (with the two spermathecae full of spermatozoa), 49 leg-bearing segments, body length 15 mm (MLP).

Remarks: The localities of Manaus: INPA; secondary upland forest (02°34'S, 60°06'W); and Lago Janauari

(all in Brazil: Amazonas State), are new for the geographic distribution of *I. crabilli*.

Additional morphological information:

Female holotype: The following rectifying data can be given on the antennae: ventral and dorsal surface of a.a. II, V, IX and XIII (Figs. 15, 16) with very small specialized sensilla. On the ventral side, these sensilla are represented by two different types: *a* and *b*. Type *a* sensilla are very thin and not split apically (Fig. 15: a); type *b* sensilla, thicker than type *a*, hyaline, and having two very small apical branches (Fig. 15: b). Specialized sensilla on dorsal side represented by three different types: *a* and *b*, similar to *a* and *b* of ventral side (Fig. 16: a, b); and type *c* sensilla "spine-like" or "claviform" larger and much darker (ochreous) in color (Fig. 16: c). Number and distribution of specialized sensilla on a.a. II, V, IX and XIII, as in Table 2.

Remarks: The original description by Pereira *et al.* (1994), only mentions two types of specialized sensilla (hereby individualized as "type *b*" and "type *c*"). The original source of this nomenclature is Pereira *et al.* (1995).

Post-embryonic variation of coxal organs: the juvenile cited above, has 1+1 coxal organs in the coxopleura of the ultimate leg-bearing segment (Fig. 17); in contrast, mature specimens have 2+2 coxal organs.

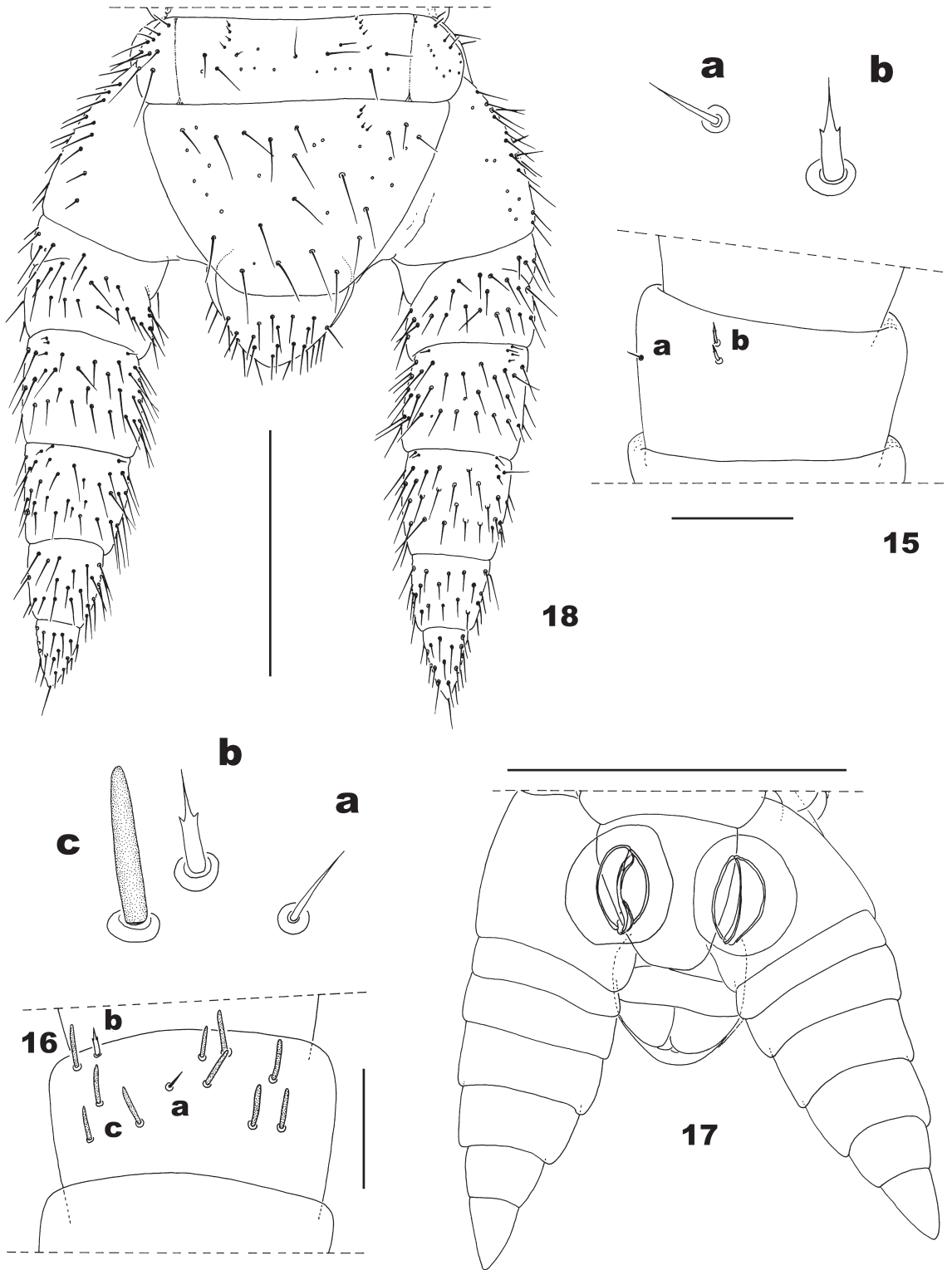
Variation: all males recorded up to now have 47 leg-bearing segments, females with 47, 49, 51 or 53 leg-bearing segments.

Type locality: Brazil: Amazonas: Rio Tarumã Mirim.

Known range: BRAZIL: Amazonas: Tarumã Mirim River; Adolpho Ducke Forest Reserve; Manaus: INPA; secondary upland forest (02°34'S, 60°06'W); Janauari Lake.

TABLE 2: Number of type *a*, *b* and *c* sensilla on antennal articles II, V, IX and XIII in the holotype female of *Ityphilus crabilli* Pereira, Minelli & Barbieri, 1994 from Brazil: Amazonas: Rio Tarumã Mirim.

	Ventral		Dorsal			Figs.
	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>	<i>c</i>	
II		2				
V	1	1-2	1	1	10	15, 16
IX	1	1	1	1-2	8-10	
XIII	1	1	1	2-3	4-5	



FIGURES 15-18: (15-16): *Ityphilus crabilli* Pereira, Minelli & Barbieri, 1994, (female holotype; Brazil: Amazonas: Rio Tarumá Mirim): (15) Left a.a. V, ventral (a, b: a, b type sensilla); (16) Left a.a. V, dorsal (a, b, c: a, b, c type sensilla). (17): *Ityphilus crabilli* Pereira, Minelli & Barbieri, 1994, (juvenile (female?); Brazil: Amazonas: 02°34'S, 60°06'W): Ultimate leg-bearing segment and postpedal segments, ventral. (18): *Ityphilus demoraisi* Pereira, Minelli & Barbieri, 1995, (male (Specimen "A"); Brazil: Amazonas: 02°34'S, 60°06'W): Ultimate leg-bearing segment and postpedal segments, dorsal. Scale bars: 0.05 mm (15, 16); 0.2 mm (17); 0.4 mm (18).

***Ityphilus demoraisi* Pereira, Minelli & Barbieri, 1995
(Figs. 18-25)**

Ityphilus demoraisi Pereira, Minelli & Barbieri, 1995:325, 327, 328; Pereira & Minelli, 1996:110; Adis *et al.*, 1996:166, 168; Pereira *et al.*, 2000:8; Foddai *et al.*, 2000:153; 2002:473; 2004:276; Bonato *et al.*, 2007:3; Pereira, 2010:660.

New material examined: BRAZIL: Amazonas: secondary upland forest (02°34'S, 60°06'W), 3 January 1991, M.O. de A. Ribeiro leg.: 1 male (Specimen "A") with 63 leg-bearing segments, body length 30 mm (MLP); same locality and collector, 28 August 1990: 1 male (Specimen "B") with 65 leg-bearing segments, body length 29 mm (MLP).

Remarks: The locality cited above, is new for the geographic distribution of this species.

The adult condition of the two specimens listed here is proved by the tubula seminifera full of mature spermatozoa.

The original description by Pereira *et al.* (1995) was based on females only (holotype, paratype, and a juvenile). Subsequently, no specimens have been reported for this species, thus the male remained unknown until now; the present new material allows the first description of this sex, giving a better understanding of the taxon.

Description

Male (Specimen A): Sixty-three leg-bearing segments, body length 30 mm, maximum body width 0.8 mm.

Features similar to those in the female, except for the shape and chaetotaxy of the ultimate leg-bearing segment and postpedal segments.

Ultimate leg-bearing segment: conspicuously wider than the penultimate leg-bearing segment, in the proportion *ca.* 1.63: 1; length/width ratio of tergite, 0.63: 1; length/width ratio of sternite: 0.75: 1. Shape and chaetotaxy of tergite and sternite as in Figs. 18, 19. Coxopleura with numerous setae on ventral and lateral surfaces, dorsal side with few setae placed near the lateral edges only (Figs. 18, 19). Coxal organs with shape and relative size as in Figs. 19, 20. Articles of ultimate legs strongly thickened, subconically narrowing from base to distal end (ratio of width of trochanter/width of tarsus 2, *ca.* 3.0: 1); ultimate legs relatively longer than those of the female, with ratio

length of telopodites/length of sternite, 2.57: 1. Shape and chaetotaxy of ultimate legs as in Figs. 18, 19.

Postpedal segments: intermediate tergite with posterior margin strongly convex (Fig. 18), intermediate sternite and first genital sternite with posterior margin slightly concave (Figs. 19, 21). Gonopods apparently uniaarticulate (suture between the presumptive basal and apical articles not evident), right gonopod with 12 setae on ventral side (Fig. 22). Penis apparently devoid of apical setae, shape as in Fig. 23.

Variation: the females recorded up to now have 67 or 69 leg-bearing segments; the males 63 or 65 leg-bearing segments.

The anterior and posterior coxal organs of the female holotype (Figs. 24, 25), and those of female paratype, are roughly similar in size; in contrast, in both males examined here the anterior coxal organs are smaller than the posterior (in the proportion shown in Figs. 19, 20). Because there is no doubt about the conspecificity of the present males with the holotype and paratype female, this difference could be interpreted as an intraspecific variation (or artifacts in the temporary microscope slides). More specimens are needed to clarify this issue.

Ecology: The two specimens herein reported were collected in a secondary forest, while the type material comes from a primary rainforest at the Adolpho Ducke Forest Reserve, a 100 Km² high biodiversity area belonging to INPA, located near the city of Manaus. (A description of its geology, soil characteristics and floristic composition is given by Gentry, 1990; Hopkins, 2005, 2007; Penny & Arias, 1982; and Ribeiro *et al.*, 1999).

Type locality: Brazil: Amazonas: Reserva Florestal A. Ducke (02°55'S, 59°59'W).

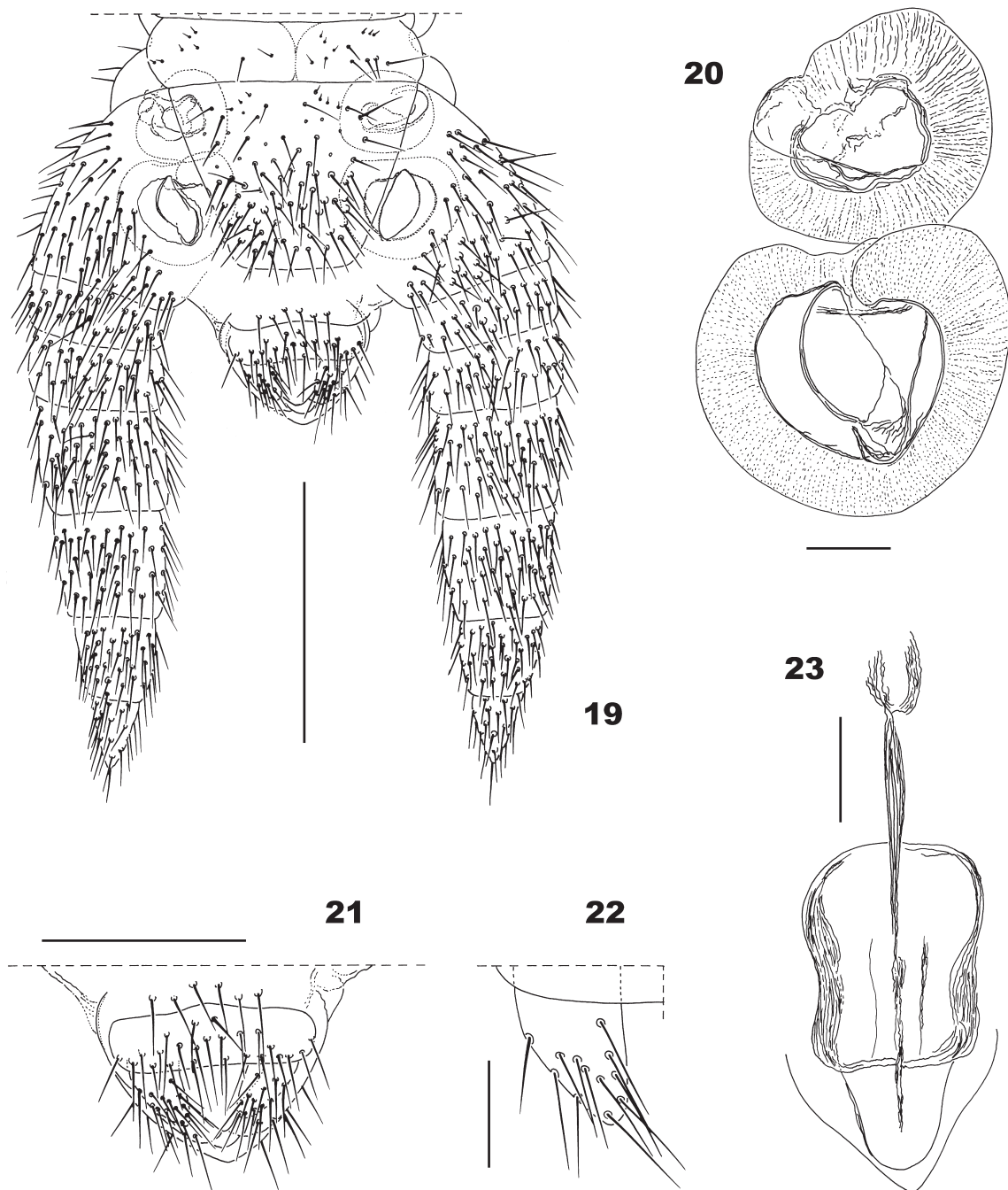
Known range: BRAZIL: Amazonas: Adolpho Ducke Forest Reserve (02°55'S, 59°59'W); secondary upland forest (02°34'S, 60°06'W).

***Ityphilus calinus* Chamberlin, 1957
(Fig. 26)**

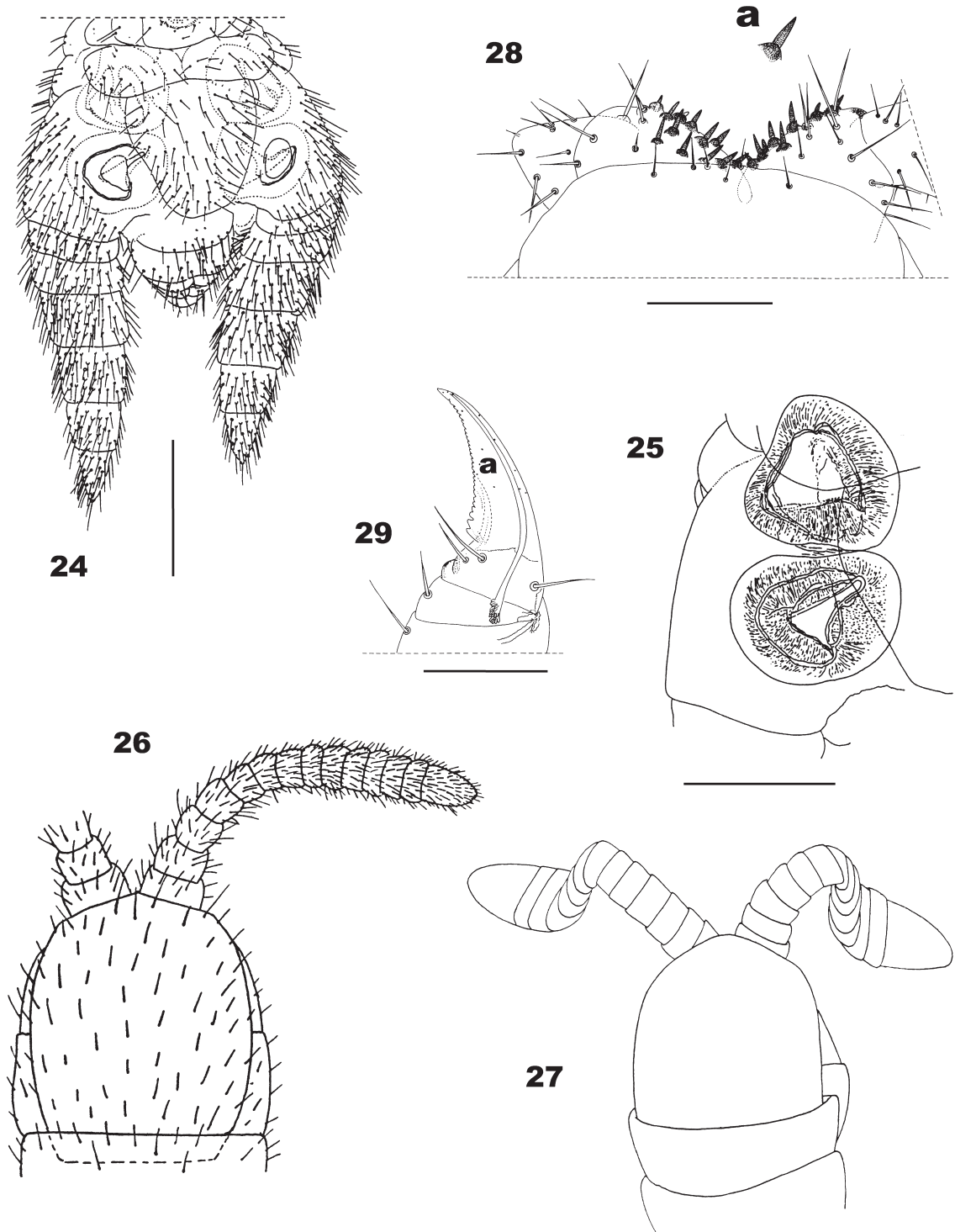
Ityphilus calinus Chamberlin, 1957:25, 30; Pereira & Minelli, 1996:110; Foddai *et al.*, 2000:153; Adis *et al.*, 2002:18; Foddai *et al.*, 2002:473; 2004:276; Bonato *et al.*, 2007:3; Pereira, 2010:663.

Diagnosis: An *Ityphilus* species characterized by having a low number of leg-bearing segments (43). Among the other Neotropical members of the genus, it only shares the same trait with *I. donatellae* sp. nov.; *I. calinus* can be principally differentiated from the latter by means of the following selected traits (those

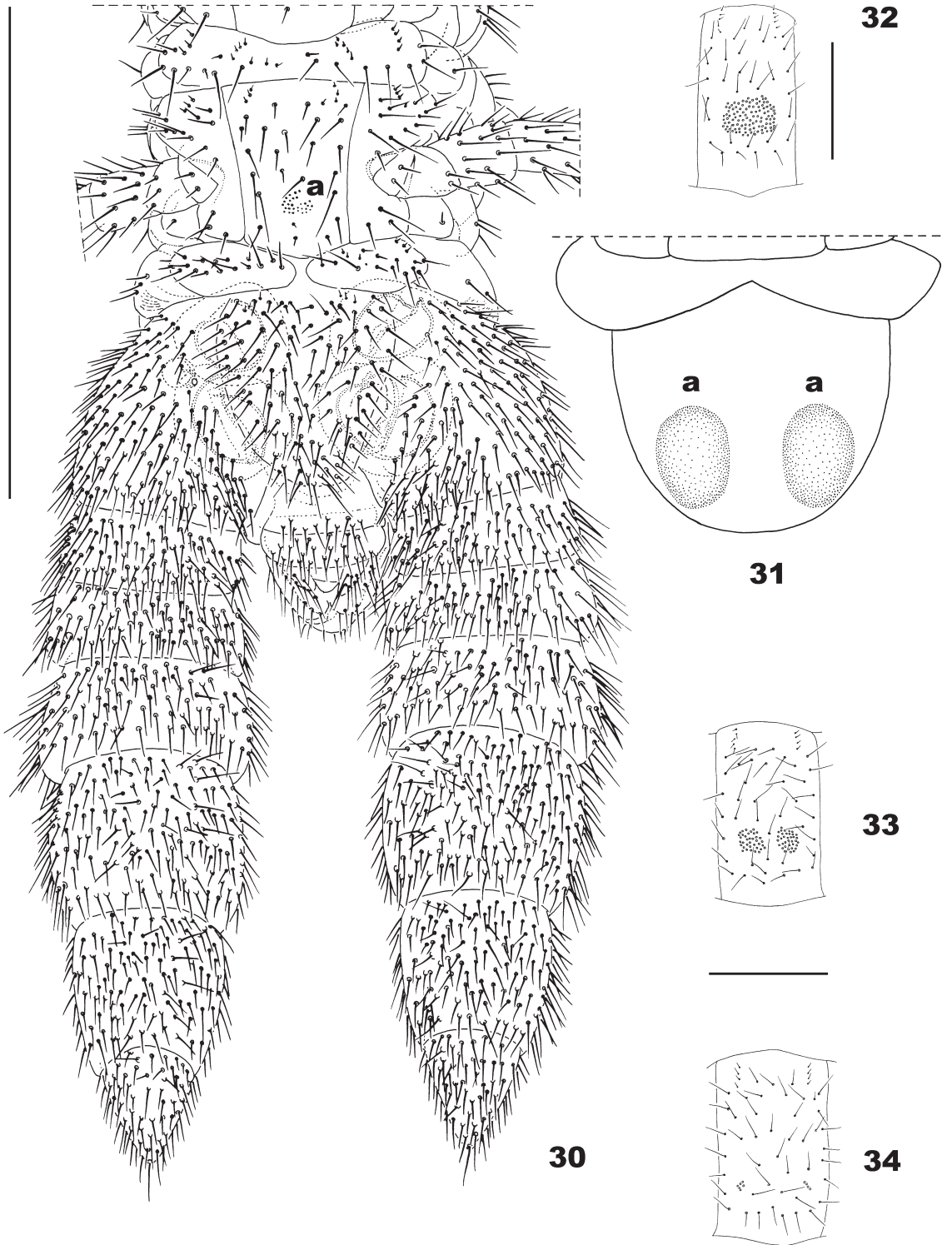
for *I. donatellae* are given in parentheses): “Antennae curved at middle but not truly geniculate”, Fig. 26 (curved at middle, truly geniculate, Figs. 1, 9, 10, 12); antennae distally slightly thickened, Fig. 26 (antennae distally strongly clavate, Figs. 1, 9, 10, 12); a.a. XIV longer than wide, in the proportion *ca.* 1.49: 1 (a.a.



FIGURES 19-23: *Ityphilus demoraissi* Pereira, Minelli & Barbieri, 1995, (male (Specimen “A”); Brazil: Amazonas: 02°34’S, 60°06’W): (19) Ultimate leg-bearing segment and postpedal segments, ventral; (20) Right coxal organs, ventral; (21) Detail of postpedal segments, ventral; (22) Right gonopod, ventral; (23) Penis, dorsal. Scale bars: 0.05 mm (20, 22, 23); 0.2 mm (21); 0.4 mm (19).



FIGURES 24-29: (24-25): *Itypbilus demoraisi* Pereira, Minelli & Barbieri, 1995, (female holotype; Brazil: Amazonas: Adolpho Ducke Forest Reserve): (24) Ultimate leg-bearing segment and postpedal segments, ventral; (25) Right coxal organs, ventral (From Pereira *et al.*, 1995). (26): *Itypbilus calinus* Chamberlin, 1957 (male holotype; "Colombia: 13 mi. W. of Cali, Valle"): Anterior end of the body, dorsal. (From Chamberlin, 1957). (27): *Itypbilus ceibanus* Chamberlin, 1922, (type (sex?); Honduras: La Ceiba): Anterior end of body, dorsal. (From Chamberlin, 1922). (28-29): *Itypbilus sensibilis* Pereira, Foddai & Minelli, 2000, (female holotype; Brazil: Amazonas: 02°34'S, 60°06'W): (28) Clypeus and bases of antennae (a: strong stout seta); (29) Detail of duct and calyx of poison gland in left forcipular telopodite, ventral (a: internal edge of tarsungulum, entirely serrate). (From Pereira *et al.* 2000). Scale bars: 0.1 mm (28, 29); 0.2 mm (25); 0.3 mm (24); no scales available (26, 27).



FIGURES 30-34: (30): *Ityphilus betschi* Pereira, 2010, (male holotype; French Guiana: piste de St. Elie; 16 km from Sinnamary): Penultimate and ultimate leg-bearing segments, and postpedal segments, ventral (a: pore-field). (Modified from Pereira, 2010). (31): *Ityphilus mauriesi* Demange & Pereira, 1985, (female holotype; French Antilles: Guadeloupe): Sternite of ultimate leg-bearing segment (a: ovoid prominences). (Modified from Demange & Pereira, 1985). (32-34): *Ityphilus krausi* Pereira & Minelli, 1996, (male holotype; Peru: Atiq-uipa): (32) Sternite of leg-bearing segment 28; (33) Sternite of leg-bearing segment 34; (34) Sternite of leg-bearing segment 40. (After Pereira & Minelli, 1996). Scale bars: 0.3 mm (32-34); 1.0 mm (30); no scale available (31).

XIV wider than long, in the proportion *ca.* 0.93: 1). Other features differentiating both species, as in Table 1.

Remarks: This species was insufficiently described by Chamberlin (1957) on the basis of a single specimen (male holotype). The original description does not state whether the forcipular tarsungulum is serrate or smooth, lacks information on many other important characters of specific value, and only includes a single figure (illustrating the anterior end of the body), which is herein reproduced as Fig. 26. However, a few approximate ratios related to antennal articles and cephalic plate (included here in Table 1 as indicative traits for this species), are tentatively deduced from this original figure.

Pereira *et al.* (2000) stated that the original description of *I. calinus* is entirely devoid of figures. However that statement was an inadvertent mistake, since “fig. 7” of Chamberlin (on page 23 of his paper) does correspond to this taxon.

The type locality given by this author may be more appropriately cited as follows: Colombia: Valle del Cauca Department: 13 mi. W. of Santiago de Cali. (This town is located in the geographic valley of the Cauca River, on the west bank of the water course, about 1000 m a.s.l., between the Central Cordillera and the Occidental Cordillera of the Andes (very close to the latter)). Chamberlin does not give the altitude a.s.l. of the collecting site (thirteen miles West of the mentioned city as stated above, (Fig. 35)).

The inclusion of Brazil in the geographic distribution of *I. calinus* by Adis *et al.* (2002); Foddai *et al.* (2000, 2002, 2004); Pereira *et al.* (2000); and Bonato *et al.* (2007) is not valid, because it was based on the specimens herein identified as *I. donatellae* sp. nov.

Type locality: “Colombia: 13 mi. W. of Cali, Valle”.

Known range: Only known from the type locality.

Key to the Neotropical species of *Ityphilus* with forcipular tarsungulum serrate

1. Internal edge of forcipular tarsungulum entirely serrate (Fig. 29: a); internal side of a.a. I with strong stout setae (Fig. 28: a); coxosternite of second maxillae with a sulcus along the sagittal plane..... *I. sensibilis* Pereira, Foddai & Minelli, 2000
- Internal edge of forcipular tarsungulum partially serrate; internal side of a.a. I without strong stout setae; coxosternite of second maxillae without a sulcus along the sagittal plane..... 2
2. 113 leg-bearing segments (female), body length 93 mm *I. grandis* (Turk, 1955)
- 41 to 95 leg-bearing segments, body length 8.5 to 83 mm..... 3
3. 95 leg-bearing segments (female); body length 83 mm; sternites of posterior third of the body without pore-fields; sternite of the ultimate leg-bearing segment with 1+1 ovoid prominences on the posterior half (Fig. 31: a) *I. mauriesi* Demange & Pereira, 1985
- 41 to 71 leg-bearing segments; body length 8.5 to 57 mm; sternites of posterior third of the body with pore-fields 4
4. Ventral pore-fields of anterior half of the body undivided (Fig. 32), those of the posterior half divided in two subsymmetrical areas (Figs. 33, 34) *I. krausi* Pereira & Minelli, 1996
- All pore-fields undivided..... 5
5. 41 or 43 leg-bearing segments, body length 8.5 to 11 mm..... *I. donatellae* sp. nov.
- 47 to 71 leg-bearing segments, body length 15 to 57 mm..... 6
6. Sternite of leg-bearing segment 1 with pore-field 7
- Sternite of leg-bearing segment 1 without pore-field 8
7. Male with 63, 65 leg-bearing segments, female with 67, 69 leg-bearing segments; body length 30-32 mm; antennae distally moderately clavate; chitin-lines of forcipular coxosternite complete.....
- *I. demoraisi* Pereira, Minelli & Barbieri, 1995
- 49, 55 leg-bearing segments; body length 23 mm; antennae distally strongly clavate; chitin-lines of forcipular coxosternite incomplete *I. guianensis* Chamberlin, 1921
8. Sternite of leg-bearing segment 2 without a well defined pore-field (only an isolated pore can be present); anterior edge of forcipular coxosternite deeply notched at middle; chitin-lines of forcipular coxosternite complete; ratio of maximum length/maximum width of forcipular trochanteroprefemur *ca.* 1.32: 1.....
- *I. saucius* Pereira, Foddai & Minelli, 2000

- Sternite of leg-bearing segment 2 with a well defined pore-field; anterior edge of forcipular coxosternite not deeply notched at middle; chitin-lines of forcipular coxosternite incomplete; ratio of maximum length/maximum width of forcipular trochanteroprefemur *ca.* 1.10-1.17: 1.....9
- 9. Male with 47, female with 47, 49, 51, 53 leg-bearing segments*I. crabilli* Pereira, Minelli & Barbieri, 1994
- With 61 to 71 leg-bearing segments10
- 10. 61 (male), 63 (male, female?) leg-bearing segments; body length 17-18 mm; first maxillae without lappets; ventral pore-fields extending to antepenultimate leg-bearing segment*I. perrieri* (Brölemann, 1909)
- 67 (male), 71 (female) leg-bearing segments; body length: 40 mm (male), 57 mm (female); first maxillary lappets present on coxosternite and telopodites; ventral pore-fields extending to penultimate leg-bearing segment (Fig. 30: a) *I. betschi* Pereira, 2010



FIGURE 35: Map of the Colombian Andean region showing the Oriental, Central, and Occidental Cordillera. The black dot between the two last (in the Cauca River Valley), indicates the approximate location of the type locality of *Ityphilus calinus* Chamberlin, 1957.

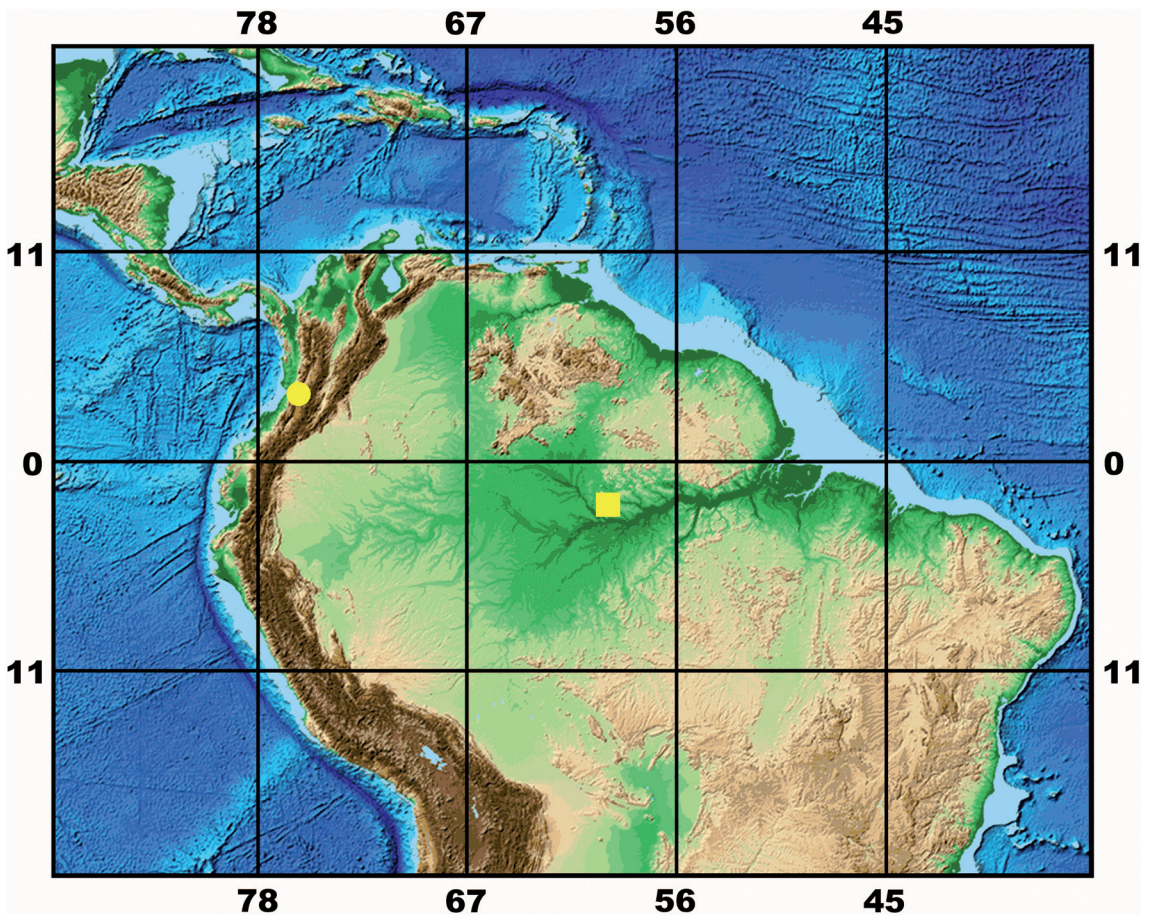


FIGURE 36: Geographical distribution of *Ityphilus calinus* Chamberlin, 1957 (dot) and *Ityphilus donatellae* sp. nov. (square). (Map adapted from Amante, C. & Eakins, B.W., 2009).

DISCUSSION

As is the case for *Ityphilus donatellae* sp. nov. (just 8.5 to 11 mm long), diverse other examples of reduced body size exist within the order Geophilomorpha (see Foddai *et al.*, 2003; Minelli *et al.*, 2000; Pereira 2009, 2011). Besides the Ballophilidae, this is known to occur in some genera of the Geophilidae, Linotaeniidae, Schendylidae, Mecistocephalidae, and Macronicophilidae (within *Macronicophilus* Silvestri, 1909, where *M. abbreviatus* Pereira, Foddai & Minelli, 2000, with 39 or 41 leg-bearing segments is 16 mm long).

The key proposed above will enable the identification of the eleven Neotropical species of *Ityphilus* known to have the forcipular tarsungulum serrate (including *I. donatellae* sp. nov. which shares this feature). Among the eight remaining Neotropical species in the genus, five have a smooth forcipular tarsungulum (so they are not covered in this key). As for the other three taxa (*I. calinus* Chamberlin, 1957

(from Colombia); *I. savannus* Chamberlin, 1943 (from Mexico) and *I. ceibanus* Chamberlin, 1922 (from Honduras)), the original descriptions do not state whether the forcipular tarsungulum is serrate or smooth, thus their insertion in the key would be conditional (and uncertain). However, in the case of these species actually having a serrate tarsungulum, they could be differentiated from those included in the latter as follows:

- *I. calinus*: with 43 leg-bearing segments, can be separated from *I. donatellae* sp. nov. (with 41, 43 leg-bearing segments) by means of the selected traits shown in Table 1.
- *I. savannus*: with greatly thickened antennae, and 55 leg-bearing segments, may be distinguished from *I. guianensis* (the single species in the key sharing these traits) by its peculiar ventral pore-field series, which extends from the second sternite to fourth sternite from rear end of the body (in *I. guianensis* the ventral pore-field

series is present from the first to penultimate sternite).

- *I. ceibanus*: the incomplete trunk of the single type specimen has 69 leg-bearing segments. It could be differentiated from the three species in the key that have a similar trait (*i.e.*, *I. betschi*, *I. demoraisi* and *I. saucius*) by its strongly clavate antennae (Fig. 27) (these appendages are slightly thickened in *I. betschi* and moderately clavate in *I. demoraisi* and *I. saucius*). Anyway, Chamberlin (1922) affirms in his original description “the total number of pairs of legs is not ascertainable because the caudal end of the type is missing”. In consequence, the kind and number of coxal organs and number of articles of the ultimate legs (and other characters of generic value) are unknown for the species; for this reason, it is even doubtful if it really belongs to *Ityphilus*.

Five species of the genus (in addition to that proposed above) are recorded from Brazilian Amazonia: *I. crabilli* Pereira, Minelli & Barbieri, 1994; *I. demoraisi* Pereira, Minelli & Barbieri, 1995; *I. donatellae* sp. nov.; *I. guianensis* Chamberlin, 1921; *I. saucius* Pereira, Foddai & Minelli, 2000; and *I. sensibilis* Pereira, Foddai & Minelli, 2000. In addition to these taxa, twenty five further species of geophilomorph centipedes are known to occur in this region: one species in the genus *Taeniolum* Pocock, 1893 (Ballophilidae); two in *Hyphydrophilus* Pereira, Minelli & Barbieri, 1994, six in *Ribautia* Brölemann, 1909, and one in *Schizonampa* Chamberlin, 1914 (Geophilidae); two in *Macronicophilus* Silvestri, 1909 (Macronicophilidae); one in *Mecistocephalus* (Mecistocephalidae); one in *Notiphilides* Latzel, 1880, and two in *Orphnaeus* Meinert, 1870 (Oryidae); three in *Pectiniunguis* Bollman, 1889, and six in *Schendyllops* Cook, 1899 (Schendylidae).

At the specific level, the geophilomorphs from Brazilian Amazonia show a high degree of endemism; in contrast, at generic level only one genus (*Hyphydrophilus*) is endemic to this region (Foddai *et al.*, 2004). The majority of the recorded species have been collected in some biotopes in the vicinity of Manaus (Amazonas State, Central Amazon), but nothing is known about members of the order that most probably exist in large areas never explored, demonstrating that the current knowledge of this group in the Neotropics (and in this immense Brazilian region in particular) is still very scanty and fragmentary. The Brazilian Amazon region as a whole consists of over 4,000,000 km² of tropical rain forest, representing one of the largest and most diverse contiguous ecosystems in the

world (Braswell *et al.*, 2003). According to da Silva *et al.* (2005), our knowledge of the diversity, phylogeny and distribution of organisms in Amazonia is still in its infancy. There are large areas not yet visited by specialists (Nelson *et al.*, 1990; Oren & Albuquerque, 1991), *e.g.*, more than seventy percent of the total surface of the Amazon basin remains unexplored for the arachnid order Opiliones (Tourinho & Pérez González, 2006). This region has been less investigated than the southeastern and southern regions of Brazil, thus its faunistic diversity is less known (and underestimated). Therefore it is not surprising that several new taxa, including new species of mammals, were discovered lately (van Roosmalen *et al.* 1998, 2000, 2002; van Roosmalen & van Roosmalen, 2003; Voss & da Silva 2001).

Amazonian biodiversity is principally threatened by deforestation (Braswell *et al.*, 2003; Fearnside, 2003; Houghton *et al.*, 2000; Myers, 1992; Potter *et al.*, 2001). We do not know the susceptibility of geophilomorph centipedes to habitat fragmentation, agriculture, environmental climatic changes, etc. Several new species probably exist in areas never sampled in a landscape under increasing pressure from human activities; many of them could probably disappear before we get to know them.

RESUMEN

Una nueva especie enana del género de ciempiés Ityphilus Cook, 1899, denominada I. donatellae sp. nov. (Chilopoda: Geophilomorpha: Ballophilidae), es aquí propuesta sobre la base de ejemplares provenientes de las cercanías de Manaus, Amazonia Central (Brasil), previamente identificados como Ityphilus calinus Chamberlin, 1957 (aquí designados holotipo hembra, paratipo macho y paratipo hembra). Datos morfológicos suplementarios y nuevas ilustraciones son provistos sobre la base de este material tipo. La nueva especie, caracterizada por tener el borde interno de la tarsungula forcipular serrado, es aquí incluida en una clave que permitirá la identificación de todos los miembros neotropicales del género Ityphilus que comparten el mismo carácter. Nuevos registros de distribución y notas descriptivas suplementarias para Ityphilus crabilli Pereira, Minelli & Barbieri, 1994, e Ityphilus demoraisi Pereira, Minelli & Barbieri, 1995 (incluyendo la primera descripción del macho de esta última) son también brindados. Se ha utilizado 2-Phenoxyethanol (CAS No. 122-99-6) no diluido, como un efectivo agente de diafanización (y a la vez medio de montaje), para la realización de preparaciones microscópicas transitorias de todas las partes del cuerpo de los especímenes examinados.

PALABRAS-CLAVE: *Ityphilus*; Taxonomía; Nueva especie; Nuevos registros de distribución; Amazonia Central; Brasil; Geophilomorpha; Ballophilidae

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