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ECOSYSTEMS

First record of *Tmesiphantes* Simon, 1892 (Araneae, Theraphosidae) in Peru: a new species and its phylogenetic placement

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Abstract: The tarantula genus *Tmesiphantes* Simon, 1892 includes 20 valid species distributed in Argentina and Brazil. These spiders are distinguished from other Theraphosinae genera by the presence of an incrassate femur III, more evident in males, urticating hair types III and IV on the abdominal dorsum, few cuspules on the labium (0 to 30), maxillae with a maximum of 200 cuspules and sternum rounded. From recent examination of material from Peru, we discovered specimens that share all the morphological characters of *Tmesiphantes*, but did not fit with any known species. In the present study *T. intiyaykuy* sp. nov. is diagnosed, described, and illustrated. This new species resembles *T. caymmii* in the circular patch with stiff setae on midventral abdomen but can be distinguished by the shape of the palpal bulb and spermathecae. Also, we performed a phylogenetic analysis using morphological characters to infer the taxonomic placement of the new species. The analysis included 26 terminal species and 36 characters. Representatives of *Tmesiphantes* formed a monophyletic group and *T. intiyaykuy* sp. nov. is close related with *T. caymmii*. A dichotomous identification key and a geographic distribution map were constructed for recognized species of *Tmesiphantes*.

Key words: South America, Apurimac, taxonomy, Mygalomorphae, cladistics.

INTRODUCTION

Among mygalomorph spiders, Theraphosidae is the most diverse family with 1032 species known to date (World Spider Catalog 2022). Theraphosidae includes spiders commonly known as tarantulas, and are distributed worldwide mainly in tropical and subtropical areas. The subfamily Theraphosinae is endemic from the New World and comprises more than 60 formally genera described (World Spider Catalog 2022). This subfamily is a monophyletic group characterized by the following synapomorphies: presence of urticating setae type III, male palpal bulb with subtegulum extended over the tegulum, embolus with keels and tarsal clavate trichobotria in a straight row (Raven 1985, Pérez-Miles et al. 1996, Bertani 2001, Bertani & Guadanucci 2013, Guadanucci 2014, Fabiano-da-Silva et al. 2019).

The genus *Tmesiphantes* Simon, 1892 belongs to the subfamily Theraphosinae and comprises small to medium-sized spiders with an incrassate femur III. Representatives of this genus are also recognized by the few cuspules (less than 30) on the labium and maxillae. In particular, males are characterized by the following combination of characters: tibial spur consisting of two separated (not fused) branches and a well-developed retrolateral branch, which can have a rigid spine on the apex, the prolateral branch shorter than retrolateral, and can have an adjacent short spine; and male palpal bulb embolus, which can be twisted or straight, bearing prolateral

keels only (superior and inferior). Females are characterized by a spermathecae composed of two receptacula with a subapical constriction (Pérez-Miles et al. 1996, Yamamoto et al. 2007, Fabiano-da-Silva et al. 2019). Recently, Fabiano-da-Silva et al. (2019) reviewed the taxonomy and performed a phylogenetic analysis using morphological characters of *Tmesiphantes*. From that study, four new species were described, *Tmesiphantes amazonicus* Fabiano-da-Silva et al. 2019, *T. guayarus* Fabiano-da-Silva et al. 2019, *T. nordestinus* Fabiano-da-Silva et al. 2019 and *T. raulseixasi* Fabiano-da-Silva et al. 2019, all from Brazil inhabitting in Caatinga shrublands, Cerrado savannas, Atlantic rain forest and the Brazilian Amazon. Results of the phylogenetic analyses revealed a monophyletic group including *Tmesiphantes* and those representatives of *Magulla* Simon, 1892 and *Melloleitaoina* Gerschman & Schiapelli, 1960, which led authors to propose the synonymy among those genera (Fabiano-da-Silva et al. 2019). Thus, the genus *Tmesiphantes* now comprises 20 currently recognized species: *Tmesiphantes amadoi* Yamamoto et al. 2007; *T. amazonicus*; *T. aridai* Gonzalez-Filho et al. 2014; *T. bethaniae* Yamamoto et al. 2007; *T. brescoviti* (Indicatti et al. 2008); *T. buecherli* (Indicatti et al. 2008); *T. caymmii* Yamamoto et al. 2007; *T. crassifemur* (Gerschman & Schiapelli, 1960); *T. guayarus*; *T. hypogeus* Bertani et al. 2013; *T. mirim* Fabiano-da-Silva et al. 2015; *T. mutquina* (Perafán & Pérez-Miles, 2014); *T. nordestinus*; *T. nubilus* Simon 1892; *T. obesus* (Simon, 1892); *T. perp* Guadanucci & Silva 2012; *T. raulseixasi*; *T. riopretano* Guadanucci & Silva, 2012; *T. uru* (Perafán & Pérez-Miles, 2014), and *T. yupanqui* (Perafán & Pérez-Miles, 2014). At present, the genus *Tmesiphantes* is distributed along the major Brazilian biomes and northeastern Argentina in the Yungas ecoregion (Fabiano-da-Silva et al. 2019).

Fabiano-da-Silva et al. (2019) diagnosed the genus *Tmesiphantes* as being distinguishable from other Theraphosinae genera by a distinctly incrassate femur III, more evident in males, and females of *T. amazonicus*, *T. uru*, and *T. yupanqui*; urticating hair types III and IV on abdominal dorsum; few cuspules on labium (0 to 30), up to 200 cuspules on maxillae and a rounded sternum. Additionally, the male palpal bulb embolus varies from straight to slightly curved with prolateral keels only (superior and inferior), which follows the torsion of the embolus; the tibial apophysis consists of two separated (not fused) branches: retrolateral and prolateral branches (absent in *T. guayarus*). Finally, females possess spermathecae composed of two long and slender receptacles, always with a conspicuous subapical constriction at the subapical region.

From the examination of material deposited at the Museo de Biodiversidad del Perú, a new species of *Tmesiphantes* was discovered, and is herein described and illustrated. Moreover, a new phylogenetic approach including this new species, and discussion of its position, is presented. This is the most western record of the genus *Tmesiphantes* in South America and the first record for Peru.

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MATERIALS AND METHODS

Morphology

Abbreviations: ALE = anterior lateral eyes; AME = anterior median eyes; d = dorsal; p = prolateral; PI = Prolateral inferior keel; PLE = posterior lateral eyes; PLS = posterior lateral spinnerets; PME = posterior median eyes; PMS = posterior median spinnerets; PS = prolateral superior keel; r = retrolateral; v = ventral.

The material examined in the present study is deposited in the MUBI, Museo de Biodiversidad del Perú (curator: José A. Ochoa).

All measurements are in millimeters. Total length was taken from the dorsal view and does not include the chelicera and spinnerets. Carapace length was measured from the clypeus margin to the posterior margin. Palp and leg segments were measured between the joints in dorsal view: femur, patella, tibia, metatarsus, and tarsus. The male palpal bulb and female spermathecae were dissected and stored in small vials containing 70% ethanol. Legs measurements were taken with a digital caliper to the nearest 0.001 mm and other measurements and photographs were obtained with a Zeiss Stemi 305 stereomicroscope, Zeiss AxioCam, and ZEN Imaging software v.1.0. Images were integrated by the image stacking CombineZP (Hadley 2010). Terminology for descriptions follows Fabiano-da-Silva et al. (2019). The distribution map was made using the public domain online tool SimpleMappr (Shorthouse 2010).

Cladistic analysis

Cladistic analysis was based on the previous matrix of the genus *Tmesiphantes* used by Fabiano-da-Silva et al. (2019) with some modifications. The original matrix was modified to include two new characters (35, 36) related to the keels on the embolus and some taxa used as outgroups were also modified. The only outgroup taxon kept from the original matrix was *Iridopelma hirsutum* Pocock, 1901 (subfamily Avicullariinae). The species used as new outgroups were selected based on their phylogenetic relationships with *Tmesiphantes* as previously suggested (Pérez-Miles et al. 1996, Yamamoto et al. 2007, Fukushima et al. 2008, Perafán & Pérez-Miles 2014, Fabiano-da-Silva et al. 2019): *Catumiri argentinense* (Mello-Leitão, 1941) (subfamily Ischnocolinae); *Cyriocosmus* sp.; *Grammostola doeringi* (Holmberg, 1881); *Homoeomma uruguayense* (Mello-Leitão, 1946); *Iridopelma hirsutum*; and *Plesiopelma longisternale* (Schiapelli & Gerschman, 1942). A data matrix composed of 36 morphological characters and 26 taxa has been constructed (Table I). The species *Tmesiphantes janeirus* (Keyserling, 1890) (*species inquirenda*) (Fabiano-da-Silva et al. 2019) and *T. hypogeus* (known only from females) were not included in the matrix. The new species under description was scored for the 36 morphological characters. The character matrix was assembled and edited using the computer software Mesquite version 3.61 (Maddison & Maddison 2019). The cladistics analysis was carried out in TNT version 1.5 (Goloboff & Catalano 2016), under maximum parsimony. Multistate characters were treated unordered and follow binary coding, except for characters 13, 17, and 28. Parsimony analysis was made using implied weighting and to decide upon appropriate k-values, we followed the proposal by Mirande (2009) as implemented by Fabiano-da-Silva et al. (2019) for the cladistics of the genus *Tmesiphantes*. Thus, we selected the commands 3, 10, 70, 95, and 7 for the script iw.run. Nodes without support were collapsed and only best trees were kept. Character optimization and tree editing were performed with the computer software Winclada-ASADO 1.61 (Nixon 2004).

The data matrix is listed in Table I. Characters used in the cladistics analysis are: (1) Prolateral superior keel: absent = 0, present = 1; (2) Prolateral inferior keel: absent = 0, present = 1; (3) Digitiform apophysis opposite to subtegulum: absent = 0, present = 1; (4) Distal keel on embolus: absent = 0, present = 1; (5) Rounded projection on subtegulum: absent = 0, present = 1; (6) Paraembolic apophysis on embolus: absent = 0, present = 1; (7) Flexion of metatarsus I: between the tibial apophysis

Table I. Character matrix used in the cladistics analysis of the genus *Tmesiphantes*. (?) Inapplicable, unknown or doubtful.

Taxon / Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
C. argentinense	0	0	0	0	0	0	1	0	1	0	0	0	3	0	1	0	?	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
I. hirsutum	0	0	0	0	0	0	?	?	1	1	0	0	2	0	0	1	0	1	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Cyriocosmus sp.	1	1	0	0	0	1	0	1	1	0	0	1	3	0	0	1	2	1	1	1	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0
G. doeringi	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	1	1	1	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0
H. uruguayense	1	1	1	1	0	0	0	1	1	0	0	1	0	0	0	0	2	1	1	1	0	1	0	0	0	0	0	1	0	0	1	0	0	0	1	0
P. longisternale	1	1	0	1	0	0	0	0	1	0	1	0	3	0	0	1	2	1	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
T. brescoviti	1	1	0	0	0	0	1	0	1	0	0	0	3	0	0	1	1	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0
T. buecherli	1	1	0	0	0	0	1	0	1	0	0	0	?	?	?	?	2	0	?	0	1	1	0	0	0	0	0	1	0	0	1	0	0	?	0	0
T. obesus	1	1	0	0	0	0	1	0	1	0	0	0	3	0	0	1	1	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0
T. crassifemur	1	1	0	0	0	0	1	0	1	0	0	0	?	?	?	?	2	0	?	0	1	0	0	0	0	0	1	1	0	0	1	0	1	?	0	0
T. mutquina	1	1	0	0	0	0	1	0	1	0	0	0	?	?	?	?	2	0	?	0	1	0	0	0	0	0	1	1	0	0	1	0	1	?	0	0
T. uru	1	1	0	0	0	0	1	0	1	0	0	0	2	0	0	0	2	0	1	0	1	0	0	0	0	0	1	1	0	0	1	0	1	1	0	0
T. yupanqui	1	1	0	0	0	0	1	0	1	0	0	0	2	0	0	0	2	0	1	0	1	0	0	0	0	0	1	1	0	0	1	0	1	1	0	0
T. nubilus	1	1	0	0	0	0	1	0	1	0	0	0	3	0	1	0	2	0	1	0	1	1	0	0	0	0	0	2	1	0	1	0	0	0	0	0
T. amadoi	1	1	0	0	0	0	1	0	1	0	0	0	?	?	?	?	2	0	?	0	1	1	0	0	0	0	0	2	1	0	1	0	0	?	0	1
T. bethaniae	1	1	0	0	0	0	1	0	1	0	0	0	?	?	?	?	2	0	?	0	1	1	0	0	0	0	0	1	0	0	1	0	0	?	0	0
T. caymmii	1	1	0	0	0	0	1	0	1	0	0	0	3	0	0	0	2	0	1	0	1	1	0	0	0	1	0	1	0	0	1	0	0	0	1	0
T. perp	1	1	0	0	0	0	1	0	1	0	0	0	?	?	?	?	2	0	?	0	1	1	0	0	0	0	0	2	1	0	1	0	0	?	0	0
T. riopretano	1	1	0	0	0	0	1	0	1	0	0	0	3	0	0	0	2	0	1	0	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0
T. aridai	1	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	2	0	1	0	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0
T. mirim	1	1	0	0	0	0	1	0	1	0	0	0	?	?	?	?	2	0	?	0	1	0	0	0	0	0	0	1	0	0	1	0	1	?	0	0
T. raulseixasi	1	1	0	0	0	0	1	0	1	0	0	0	?	?	?	?	2	0	?	0	1	1	0	1	0	0	0	2	0	0	1	0	0	?	0	0
T. amazonicus	1	1	0	0	0	0	1	0	1	0	0	0	3	0	0	0	2	0	1	0	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0
T. nordestinus	1	1	0	0	1	0	1	0	1	0	0	0	3	0	0	0	2	0	1	0	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0
T. guayarus	1	1	0	0	1	0	1	0	1	0	0	0	?	?	?	?	2	0	?	0	1	1	0	0	0	0	0	0	0	1	0	0	0	?	0	0
***T. intiyaykuy* sp. nov.**	1	1	0	0	0	0	1	0	1	0	0	0	2	0	0	0	2	0	1	0	1	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0

branches = 0, external to retrolateral branch of tibial apophysis = 1; (8) Base of tibial apophysis branches: separated = 0, fused = 1; (9) Tibial apophysis branches: converging = 0, diverging = 1; (10) Spiniform tibial apophysis: absent = 0, present = 1; (11) Lateral nodule on male metatarsus I: absent = 0, present = 1; (12) Retrolateral nodule on male palpal tibia: absent = 0, present = 1; (13) General spermatheca shape: short, as long as wide = 0, long, base of the same width as the apex = 1, long, base wide with subapical narrowing = 2, long, base thinner than the apex = 3; (14) Spermatheca texture: smooth, without nodules = 0, rough, covered with small nodules = 1; (15) Receptacles of spermatheca: separated at base = 0, fused at base = 1; (16) Shape of subapical region of receptacles of spermatheca: cylindrical = 0, spiraled = 1; (17) Morphology and distribution of urticating setae on abdomen dorsum: urticating setae type II in a central patch = 0; urticating setae type IV in a central patch, with two anterior groups of type III setae = 1, urticating setae type IV disposed around the central patch of type III setae = 2; (18) Sternum shape: rounded = 0, longer than wide = 1; (19) Proportion metatarsus/tarsus on females: metatarsus shorter or the same length of tarsus = 0, metatarsus much longer than tarsus = 1; (20) Labial cuspules: less than 30 = 0, more than 30 = 1; (21) Male femur III width: similar to other legs = 0, incrassate, wider than other legs = 1; (22) Posterior sternal sigillae: close to margin, touching sternal margin = 0, distant from margin by at least its diameter = 1; (23) Shape of carapace, posterior to eye tubercle: straight = 0, presence of bulge, elevated = 1; (24) Midventral portion of metatarsus I: smooth = 0, with group of three short spines = 1; (25) Lateral stripes on abdomen: absent = 0, present = 1; (26) Circular patch with stiff setae on midventral abdomen: absent = 0, present = 1; (27) Dorsal surface of tegulum: straight = 0, concave = 1; (28) Shape of embolus: straight = 0, spiral, one curvature at embolus base = 1, two curvatures the other at embolus apical third = 2; (29) Apical embolus shape: same width of base = 0, wider than base, with a conspicuous bulge = 1; (30) Embolus length: shorter than tegulum = 0, longer than tegulum = 1; (31) Tegulum shape: rounded = 0, piriform, pear-shaped = 1; (32) Prolateral branch of male tibial apophysis: narrower than retrolateral branch = 0, much wider than retrolateral branch = 1; (33) Angle between prolateral keel and bulb long axis: less than 90 degrees = 0, 90 degrees = 1; (34) Spiniform setae on promargin of coxae III and IV of females: absent = 0, present = 1; (35) Prolateral inferior keel (PI): not serrated = 0, serrated = 1; (36) Distal serrated keel on embolus: absent = 0, present = 1.

RESULTS

Cladistics

A search using equal weights (EW) found 23 most parsimonious trees with 77 steps (CI = 50, RI = 52) and the strict consensus of these did not provide any resolution. Search with implied weighting (IW) (k-values = 1.196, 1.371, 1.585, 1.854, 2.202 and 2.67) resulted in 3 equally parsimonious trees with 60 steps. The remaining k-values (3.333, 4.435, 6.080 and 9.473) resulted in 3 equally parsimonious trees with 59 steps. The strict consensus of IW resulted in a tree with 59 steps, CI = 66 and RI = 75. The results of all analyses are shown in Table II. The trees in Fig. 1a-c are the most consistent topology from the sensitivity analysis (script iw.run) and correspond to the results of the IW analyses using K-value (concavity) of 9.743 (Table II).

Table II. Results from the phylogenetic analyses using equal weighting (EW) and implied weighting (IW) with different k-values.

IW	Tree length	Trees	Total fit
EW	77	23	-
IW (1.196)	60	3	7.322
IW (1.371)	60	3	6.869
IW (1.585)	60	3	6.389
IW (1.854)	60	3	5.876
IW (2.202)	60	3	5.328
IW (2.67)	60	3	4.74
IW (3.333)	59	3	4.091
IW (4.345)	59	3	3.376
IW (6.08)	59	3	2.603
IW (9.743)	59	3	1.758

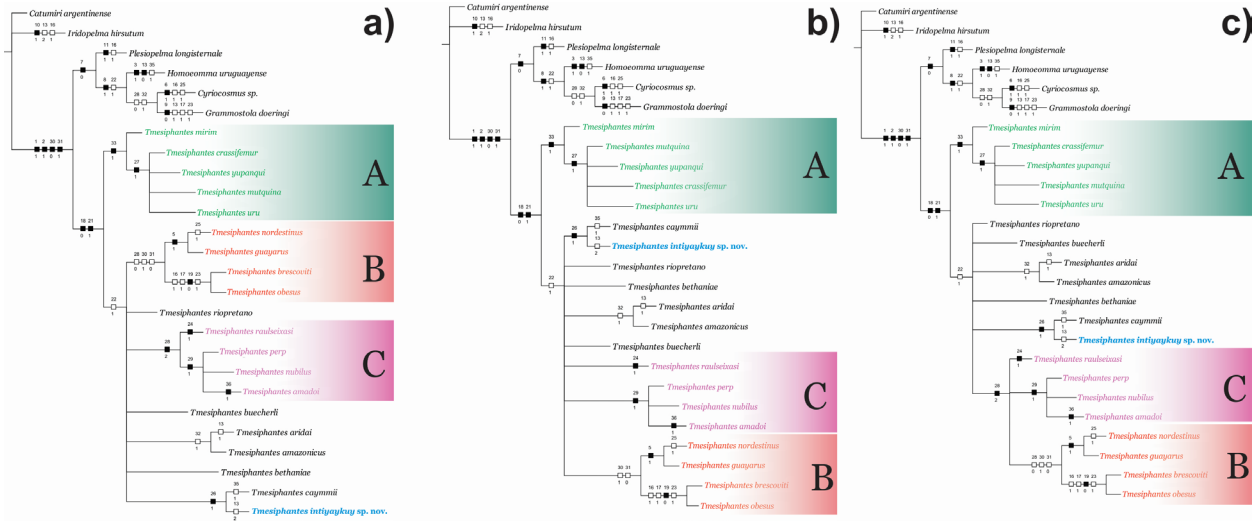

Figure 1. Most parsimonious cladograms using IW, showing the three distinct topologies of *Tmesiphantes* species (a-c). Black squares: exclusive synapomorphies; white squares: homoplasies. Numbers above the circles: characters; below: states. Clades indicated as A, B and C are the same that recovered by Fabiano-da-Silva et al. (2019).

Taxonomy

Order Araneae Clerck, 1757

Infraorder Mygalomorphae Pocock, 1892

Family Theraphosidae Thorell, 1869

Subfamily Theraphosinae Thorell, 1870

Genus *Tmesiphantes* Simon, 1892

Diagnosis. See Fabiano-da-Silva et al. 2019.

Species included: *Tmesiphantes amadoi* Yamamoto et al. 2007; *T. amazonicus* Fabiano-da-Silva et al. 2019; *T. aridai* Gonzalez-Filho et al. 2014; *T. bethaniae* Yamamoto et al. 2007; *T. brescoviti* (Indicatti et al. 2008); *T. buecherli* (Indicatti et al. 2008); *T. caymmii* Yamamoto et al. 2007; *T. crassifemur* (Perafán & Pérez-Miles, 2014), *T. guayarus* Fabiano-da-Silva et al. 2019; *T.*

hypogeus Bertani et al. 2013; *T. mirim* Fabiano-da-Silva et al. 2015; *T. mutquina* (Perafán & Pérez-Miles, 2014); *T. nordestinus* Fabiano-da-Silva et al. 2019; *T. nubilus* Simon, 1892, *T. obesus* (Simon, 1892), *T. perp* Guadanucci & Silva, 2012; *T. raulseixasi* Fabiano-da-Silva et al. 2019; *T. riopretano* Guadanucci & Silva, 2012; *T. uru* (Perafán & Pérez-Miles, 2014), *T. yupanqui* (Perafán & Pérez-Miles, 2014), *T. intiyaykuy* sp. nov.

Identification key for *Tmesiphantes* (adapted from Fabiano-da-Silva et al. 2019)

Males (male of *T. hypogeus* Bertani et al. 2013 is unknown)

1. Straight insertion of palpal bulb embolus in the tegulum, embolus long and straight (Fabiano-da-Silva et al. 2019, Fig. 20)..... **2**

Curved palpal bulb embolus insertion in tegulum, embolus curved and short (Fabiano-da-Silva et al. 2019, Fig. 3)..... **5**

2. Apical portion of embolus (palpal bulb) slightly curved (Fabiano-da-Silva et al. 2019, Fig. 31)..... **3**

Apical portion of embolus (palpal bulb) straight (Fabiano-da-Silva et al. 2019, Figs. 20-22)..... ***Tmesiphantes nordestinus***

3. Prolateral branch of tibial apophysis absent (Fabiano-da-Silva et al. 2019, Figs. 34-35), posterior sternal sigillae rounded and distant from margin (Fabiano-da-Silva et al. 2019, Fig. 33)..... ***Tmesiphantes guayarus***

Prolateral branch of tibial apophysis present, posterior sternal sigillae elongated (oval) and distant from the margin (Indicatti et al. 2008, Fig. 5c)..... **4**

4. Presence of ventral curvature along palp bulb embolus (Indicatti et al. 2008, Figs. 2a-2c)..... ***Tmesiphantes obesus***

Presence of ventral curvature restricted to the apical portion of the palp bulb embolus (Indicatti et al. 2008, Figs. 2f-2h)..... ***Tmesiphantes brescoviti***

5. Palpal bulb presents two curvatures: at the base of embolus, and also at the apical third of the embolus, with a spiral aspect (Guadanucci & Silva 2012, Figs. 11-13)..... **6**

Palp bulb without such curvature at the end portion of embolus (Yamamoto et al. 2007, Figs. 14-16)..... **9**

6. Present of a serrated keel on distal end of embolus (Yamamoto et al. 2007, Figs. 9-11)..... ***Tmesiphantes amadoi***

Absence of a serrated keel on distal end of embolus (Fabiano-da-Silva et al. 2019, Figs. 3-5)... **7**

7. Presence of a group of three short spines on ventral metatarsus I and retrolateral branch of tibial apophysis with curvature (Fabiano-da-Silva et al. 2019, Fig. 8)..... ***Tmesiphantes raulseixasi***.

Absence of a group of three short spines on ventral metatarsus I (Yamamoto et al. 2007, Figs. 6, 12)..... **8**

8. Presence of a membrane-like keel on embolus apex, which is thicker than the medial portion (Guadanucci & Silva 2012, Figs. 11-13), metatarsi I slightly curv ed..... ***Tmesiphantes perp***

Absence of a membrane-like keel on embolus apex with constant thickness (same as medial portion) (Yamamoto et al. 2007, Figs. 3-5), metatarsus I straig ht..... ***Tmesiphantes nubilus***

9. Presence of a circular patch of short hair on midventral area of the abdomen (Fig. 3f)..... **10**

Absence of a circular patch of short hair on midventral area of the abdomen..... **11**

10. Palpal bulb with serrated prolateral inferior keel (Yamamoto et al. 2007, Fig. 14), retrolateral branch of tibial apophysis much

larger than prolateral branch (Yamamoto et al. 2007, Fig. 17).....***Tmesiphantes caymmii***

Palpal bulb with prolateral inferior keel not serrated (Fig. 4c-e), retrolateral branch of tibial apophysis about equal size of prolateral branch (Fig. 3g-h)..... ***Tmesiphantes intiyaykuy*** sp. nov.

11. Presence of a triangular tooth on embolus (Perafán & Pérez-Miles 2014, Figs. 16-18).....
.....***Tmesiphantes uru***

Triangular tooth on embolus absent (Perafán & Pérez-Miles 2014, Figs. 3-5).....**12**

12. Apical portion of embolus thinner than median portion (Guadanucci & Silva 2012, Figs. 3-5).....**13**

Apical portion of embolus the same width as median portion (Fabiano-da-Silva et al. 2015, Figs. 2-4).....**16**

13. Base of the retrolateral branch of tibial apophysis straight (Guadanucci & Silva 2012, Fig. 6).....**14**

Base of the retrolateral branch of tibial apophysis recurved (Perafán & Pérez-Miles 2014, Fig. 6).....**15**

14. Prolateral branch of the tibial apophysis smaller than adjacent spine (Guadanucci & Silva 2012, Fig. 6).....
.....***Tmesiphantes riopretano***

Prolateral branch of tibial apophysis the same size as adjacent spine (Fabiano-da-Silva et al. 2019, Figs. 14-15).....
..... ***Tmesiphantes amazonicus***

15. Retrolateral branch of tibial apophysis without spine (Perafán & Pérez-Miles 2014, Fig. 6).....***Tmesiphantes crassifemur***

Retrolateral banch of tibial apophysis with spine (Indicatti et al. 2008, Figs. 2n-2o).....***Tmesiphantes buecherli***

16. Posterior sigillae near sternal margin (Fabiano-da-Silva et al. 2015, Fig. 5).....**17**

Posterior sigillae distant (by more than its diameter) from sternal margin (Fabiano-da-Silva et al. 2019, Fig. 6).....**19**

17. Prolateral branch of tibial apophysis absent (Fabiano-da-Silva et al. 2015, Figs. 6-7), very small spiders (does not exceed 6 mm in length) (Fabiano-da-Silva et al. 2015, Fig. 1).....***Tmesiphantes mirim***

Prolateral branch of tibial apophysis present (Perafán & Pérez-Miles 2014, Fig. 11), longer than 9 mm.....**18**

18. Continuous PS keel on palpal bulb embolus (Perafán & Pérez-Miles 2014, Figs. 9-11)...
.....***Tmesiphantes mutquina***

Discontinuous PS keel on palpal bulb embolus (Perafán & Pérez-Miles 2014, Figs. 28).
.....***Tmesiphantes yupanqui***

19. Retrolateral branch of tibial apophysis short, the same length of the adjacent spine (Yamamoto et al. 2007, Fig. 24).....***Tmesiphantes bethaniae***

Retrolateral branch of tibial apophysis longer than described above, with a short spine at the apex (Gonzalez-Filho et al. 2014, Fig. 5).....
.....***Tmesiphantes aridai***

Females (Females of *T. amadoi* Yamamoto et al. 2007, *T. bethaniae* Yamamoto et al. 2007, *T. buecherli* (Indicatti et al. 2008), *T. crassifemur* (Perafán & Pérez-Miles 2014), *T. guayarus* Fabiano-da-Silva et al. 2019, *T. mirim* Fabiano-da-Silva et al. 2015, *T. mutquina* (Perafán & Pérez-Miles 2014), *T. perp* Guadanucci & Silva 2012, and *T. raulsexasi* Fabiano-da-Silva et al. 2019 are unknown)

1. Presence of a circular patch of short stiff setae on midventral abdomen (Fig. 5e).....**2**

Absence of a circular patch of short stiff setae on midventral abdomen.....**3**

2. Receptacles larger than the base with a strong subapical constriction (Fig. 5g), labium with more than 20 cuspules (Fig. 5c).....
.....***Tmesiphantes intiyaykuy*** sp. nov.

Receptacles of constant width along their length (Yamamoto et al. 2007, Fig. 19), labium

with 15 cuspules or less (Yamamoto et al. 2007, Fig. 18).....***Tmesiphantes caymmii***

3. Spermathecal receptacles with fusion at the base (Yamamoto et al. 2007, Fig. 8).....***Tmesiphantes nubilus***

Spermathecal receptacles long and slender, not fused at the base (Indicatti et al. 2008, Figs. 4a-c).....**4**

4. Elevation at post-cephalic region of carapace (Indicatti et al. 2008, Fig. 5g), metatarsus I and II shorter than or of the same length as tarsi (Indicatti et al. 2008, Figs. 5h-i).....**5**

Post-cephalic region of carapace without elevation (Fabiano-da-Silva et al. 2019, Fig. 26), metatarsus I and II longer than tarsus I and II (Fabiano-da-Silva et al. 2019, Fig. 2.....**6**

5. Long seminal receptacle with the apical region above a sinuous portion claviform with ¼ the size of the whole spermathecae (Indicatti et al. 2008, Figs. 4a-c)..... ***Tmesiphantes obesus***

Short seminal receptacle with the apical region above a sinuous portion not dilated with ¼ the size of the whole spermathecae (Indicatti et al. 2008, Figs. 4d-e).....***Tmesiphantes brescoviti***

6. Apical end of spermathecal receptacles with two lobes (Fabiano-da-Silva et al. 2019, Fig. 28).....**7**

Apical end of spermathecal receptacles with a single lobe (Perafán & Pérez-Miles 2014, Fig. 25).....**8**

7. Lobes of spermathecal receptacles of unequal sizes (Fabiano-da-Silva et al. 2019, Fig. 28).....***Tmesiphantes nordestinus***

Lobes of spermathecal receptacles of similar sizes and strongly sclerotized (Fabiano-da-Silva et al. 2019, Fig. 18).....
Tmesiphantes amazonicus

8. Strong constriction at the subapical region of spermathecal receptacles, with rounded lobes (Guadanucci & Silva 2012, Fig. 8).....**9**

Wide spermathecal receptacles with mild constriction on the subapical region (Gonzalez-Filho et al. 2014, Fig. 6).....**10**

9. Spermatheca with the presence of short receptacles (shorter than the base) and large granules (Perafán & Pérez-Miles 2014, Fig. 25)..... ..... ***Tmesiphantes yupanqui***

Spermatheca with the presence of long receptacles (longer than the base) and short granules (Guadanucci & Silva 2012, Fig. 8)..... ***Tmesiphantes riopretano***

10. Anterior median eyes strongly reduced (Bertani & Guadanucci 2013, Fig. 2c), transparent ocular tubercle, region of hair urticating type III reduced into two small dorsolateral patches on abdomen (Bertani & Guadanucci 2013, Fig. 2a).....***Tmesiphantes hypogeus***

Anterior median eyes well-developed, single median patch of urticating setae type IV on abdomen dorsum (Perafán & Pérez-Miles 2014, Fig. 13).....**11**

11. Receptacles apex rounded and with strong sclerotization (Perafán & Pérez-Miles 2014, Fig. 15).....***Tmesiphantes uru***

Receptacles apex irregular and with weak sclerotization (Gonzalez-Filho et al. 2014, Fig. 6)... .....***Tmesiphantes aridai***

***Tmesiphantes intiyaykuy* sp. nov.**

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Figures 2-6, Tables III-IV

Types. Holotype male from Peru, Apurímac, Abancay, Cconoc, 13°32'35.01" S 72°38'18.97" W, 7-XII-2018, 1840 m a.s.l., Chaparro J.C., Mamani, L. leg. (MUBI 75). Paratype female from Peru, Apurímac, Abancay, 3-S Highway between Abancay and Limatambo, 13°33'2.32" S 72°38'24.30" W, 6-X-2017, 2120 m a.s.l., West R., Richards J. leg. (MUBI 40).

Additional material examined: Peru, Apurímac, Andahuaylas, Chilhuismi (near

Huancarama), 13°37'59.81" S 73°6'24.21" W, 8-XII-2018, 3363 m.a.s.l., 1 immature, Chaparro J.C., Mamani, L. leg. (MUBI 69).

Diagnosis. Differs from the all known species of *Tmesiphantes* (except from *T. caymmii*) by the presence of a circular patch of short stiff setae on midventral abdomen (Fig. 3f, 5e). Male differs from *T. caymmii* by the aspect of the palpal bulb, with inferior prolateral keel (PI) and superior prolateral keel (PS) not so distanced between them and PI not serrated (Fig. 4c-e) (serrated in *T. caymmii*, Fig. 14-16, Yamamoto et al. 2007), embolus shorter and stout and with a well-developed apical keel (A) (Fig. 4c-e) (absent in *T. caymmii*, Fig. 14-16, Yamamoto et al. 2007), and prolateral branch of tibial apophysis almost the same size as the retrolateral one (Fig. 3g-h) (prolateral branch much smaller than retrolateral one in *T. caymmii*, Fig. 17, Yamamoto et al. 2007). Female can be distinguished from the remaining species of *Tmesiphantes* by the aspect of the spermathecae, which is short with separated (not fused) base, not inclined to the outer side with a strong subapical constriction located near the base. In addition, female differs from *T. caymmii* by a higher number of labial cuspules with about 30 (15 cuspules in *T. caymmii*).

Description. Male holotype. Coloration (live specimen) (Fig. 2b): Carapace dark brown, darker on cephalic area with light brown setae mainly on margins and around the fovea. Abdomen dorsally dark brown with dark brown setae in proximal part and light brown setae in distal part, patch of urticating setae light brown. Legs dark brown with few light brown setae on distal segments. Coloration (in alcohol) (Fig. 3): Carapace slightly reddish brown with long light brown setae in margins and around the fovea, abdomen dark with a midventral circular patch of short stiff white setae and dorsally with urticating setae patch light brown. Total length (excluding chelicerae and spinnerets): 14.46. Carapace length 7.26 and width 5.80. Clypeus narrow, 0.11. Eye tubercle length 0.69 and width 1.11. Anterior eyes row slightly recurved and posterior eyes row procurved (Fig. 3e). Eyes sizes and interdistances: AME 0.16, ALE 0.36, PME 0.15, PLE 0.23, AME-AME 0.14, AME-ALE 0.08. PME-PME 0.38, PME-PLE 0.05, ALE-PLE 0.07. Labium length 0.91, width 1.18, with 7 cuspules (Fig. 3c-d). Maxillae with 100/110 (left/right) cuspules. Sternum length 3.32, width 2.94 (Fig. 3c). Sternal sigillae: small and elongated, anterior near the margin and posterior distant from margin. Chelicera with 10 well-developed teeth on prolateral margin. Leg formula: IV > I > II > III. Femora of leg III incrassate (Fig. 3i). Length of legs and palpal segments in Table III. Tarsal claws of legs I with 4 ventral teeth, leg II with 3 teeth and legs III and IV with 2 teeth each. Spination of legs and palp: Femora I 1d;

Figure 2. *Tmesiphantes intiyaykuy* sp. nov., *habitus*. (a) Female, (b) Male. Scale bars = 10 mm.

II 1d; III 2–2d; IV 1–2d; palp: 1d. Patellae: I 0; II 0; III 1p; IV 1p; palp: 0. Tibiae: I 1p, 1–1–1v; II 1p, 1–2v; III 1–1–1–1p, 5v, 1–1–1r; IV 7p, 7v, 6r; palp 1–1p (Fig. 4a-b). Metatarsi: I 1p, 2v; II 1p, 1–2v; III 7p, 1–1–2v, 1–1–1r; IV 6p, 7v, 10r. Tarsi of legs I–IV and palp without spines. Tibial apophysis (Fig. 3g-h) composed of two well-developed branches: recurved retrolateral branch with the presence of short and rigid spine inserted subapically and a prolateral branch with a retrolateral spine of about equal size of the branch. Scopulae: Tarsi I–IV fully scopulated and divided by a band of setae. Metatarsi I ½ scopulated, II 1/3 scopulated, III and IV not scopulated. Abdomen length 7.35, with urticating setae type III and IV. Spinnerets: PMS 0.90 long, PLS 2.54 long. Palpal bulb piriform with inferior and superior prolateral keels not so distanced between them and presence of an apical keel at embolus tip (Fig. 4c-e).

Female paratype. Coloration (live specimen) (Fig. 2a): Carapace brown with long light brown setae in margins and cephalic area noticeable darker. Abdomen dorsally dark brown with long yellow setae and patch of urticating setae light brown. Legs with dark femur, patella and tibia light brown and metatarsus and tarsus lighter. Coloration (in ethanol) (Fig. 5): Carapace slightly reddish brown with long light brown setae, abdomen with a midventral circular patch of short stiff white setae quite notorious and legs light brown. Total length (excluding chelicerae and spinnerets): 16.92. Carapace: length 8.18 and width 7.63. Clypeus narrow, 0.18. Eye tubercle: length 0.80 and width 1.42. Anterior eyes row slightly recurved and posterior eyes row procurved (Fig. 5d). Eyes sizes and interdistances: AME 0.18, ALE 0.28, PME 0.17, PLE 0.30, AME-AME 0.41, AME-ALE 0.03, PME-PME 0.76, PME-PLE 0.05, ALE-PLE 0.01. Labium length 1.15,

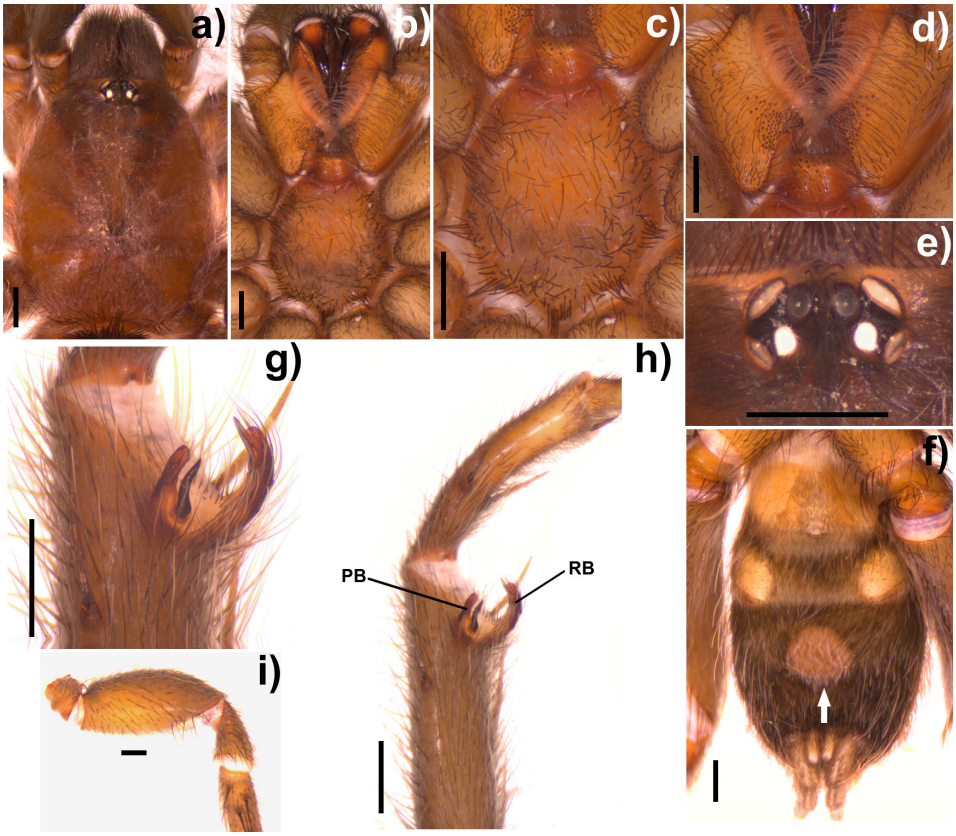

Figure 3. ***Tmesiphantes intiyaykuy*** **sp. nov., holotype male. (a) Carapace, dorsal view, (b) Sternum, labium and maxilla, ventral view, (c) Sternum, ventral view, (d) Labium and maxillae, ventral view, (e) Eyes, dorsal view, (f) Abdomen, ventral view (arrow indicates the circular patch with stiff setae), (g–h) Tibial apophysis, prolateral view, (i) Leg III, prolateral view. Abbreviations: PB = prolateral branch, RB = retrolateral branch. Scale bars = 1 mm.**

width 1.61, with 28 cuspules (Fig. 5b-c). Maxillae with 82/84 (left/right) cuspules. Sternum length 3.21, width 3.58 (Fig. 5b). Sternal sigillae: anterior near the margin and posterior distant from margin. Chelicera with 13 teeth on the prolateral margin. Leg formula: IV > I > II > III. Femora of leg III incrassate (Fig. 5f). Length of legs and palpal segments in Table IV. Tarsal claws of legs I and II with 4 ventral teeth, leg III with 1 tooth and leg IV with 3 teeth. Spination of legs and palp: Femora I; II; IV; palp: 1d; III 0. Patellae: I; II; IV; palp: 0; III 1p. Tibiae: I 1p (apical), 2v (apical); II 1–1–1p, 1–1v, 1r; III 1–1–1p, 4v (apical), 1–1r; IV 7p, 5v, 1–1–1r; palp 2p, 3v (apical). Metatarsi: I 1–1v; II 1d, 1p (apical), 1-1-2v; III 8p, 5v, 1–1r; IV 7p, 5v, 1–1–1r. Tarsi of legs I–IV and palp without spines. Scopulae: Tarsi I–IV fully scopulated and divided by a band of setae. Metatarsi I and II 1/2 scopulated, III 1/4 scopulated, IV 1/5 scopulated and palp not scopulated. Abdomen length: 7.94, with urticating setae type III and IV. Spinnerets: PMS 0.66 long, PLS 2.73 long. Spermathecae short with separated base (not fused), not inclined to the outer side with a strong subapical constriction located near the base (Fig. 5g).

Etymology. The specific epithet intiyaykuy means “west” or “sunset” in Quechua language, because the species has its westernmost geographical distribution recorded for the genus.

Distribution and natural history. *Tmesiphantes intiyaykuy* sp. nov. is known from Cconoc (Fig. 6, 7) and Chilhuismi, Department of Apurimac, Peru, at elevations between 1840–3363 m a.s.l, both are separated by 52 km in a straight line. Specimens were collected during dry and wet season, in stony and rocky areas, relatively flat, with sandy and clayey areas on the river bank of the Apurimac River. The retreat was sparsely-silked under a large angular rock lying on the surface of the ground among low scrub brush and *Pepsis* sp. (Pompilidae) were observed hunting *Tmesiphantes intiyaykuy* sp. nov. (R. West 2017, pers. com.). This species inhabits Inter-Andean dry forest, with presence of low forests, with dense to semi-open deciduous canopy 10-15 meters high, with numerous saplings, shrubs and bushes, with several tree and shrub cacti. The common floristic composition includes the genus *Acacia*, *Anadenanthera*, *Aralia*, *Caesalpinia*, *Cedrela*, *Eriotheca*, *Erythrina*, *Eriotheca*, *Escallonia*, *Fourcraea*, *Kageneckia*, *Poissonia*, and *Prosopis*. In general, the habitat has human settlements along the main road, and agriculture activities.

DISCUSSION

Results from all cladistics analyses supported the monophyly of *Tmesiphantes* as was found by Fabiano-da-Silva et al. (2019). The clades A (*Tmesiphantes mirim*, *T. crassifemur*, *T. yupanqui*, *T. mutquina* and *T. uru*) and B (*Tmesiphantes nordestinus*, *T. guayarus*, *T. brescoviti* and *T. obesus*) appeared as monophyletic in all trees and were also recovered by Fabiano-da-Silva et al. (2019). The taxa from clade A share the keels on embolus oriented in a 90° angle with the proximal-distal axis of the bulb and those from clade B are characterized by a long embolus inserted in a straight orientation into the tegulum and PS and PI keels not pronounced. The clade C (*Tmesiphantes raulseixasi*, *T. perp*, *T. nubilus* and *T. amadoi*) appeared as monophyletic only in one tree (Fig. 1a) and the species share the embolus with two curvatures (spiral shape). The remaining species that do not show the synapomorphic character state of clades A, B and C were *T. amazonicus*, *T. aridai*, *T. buecherli*, *T. bethaniae*, *T. caymmii*, *T. intiyaykuy* sp. nov. and *T. riopretano*, thus they did not fall into any of these groups. This was also reported by Fabiano-da-Silva et al. (2019) stating that intermediate palpal bulb morphology and its

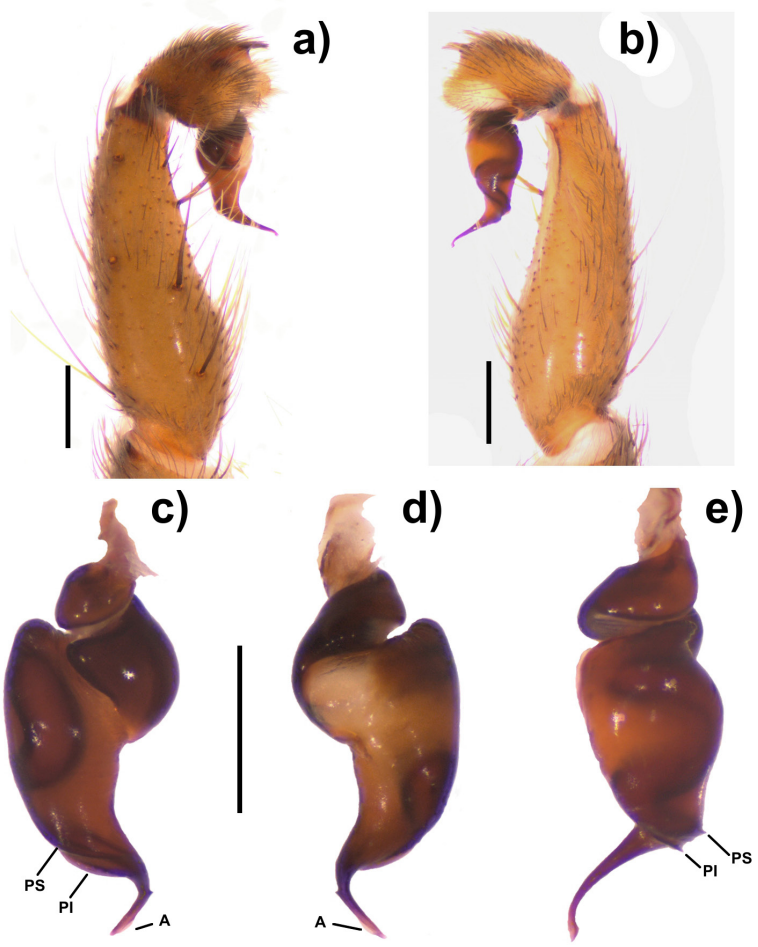

Figure 4. *Tmesiphantes intiyaykuy* sp. nov., holotype male. **(a)** Cymbium and palpal tibia, retrolateral view, **(b)** Cymbium and palpal tibia, prolateral view, **(c)** Palpal bulb, prolateral view, **(d)** Palpal bulb, retrolateral view, **(e)** Palpal bulb, dorsal view. Abbreviations: A = apical keel, PI = prolateral inferior keel, PS = prolateral superior keel. Scale bars = 1 mm.

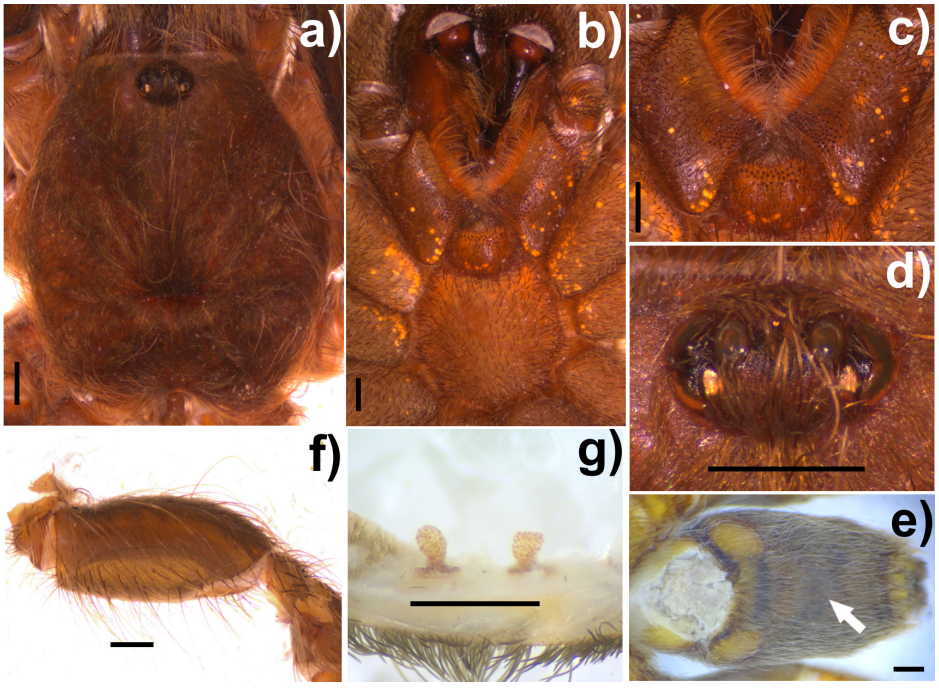

Figure 5. *Tmesiphantes intiyaykuy* sp. nov., paratype female. **(a)** Carapace, dorsal view, **(b)** Sternum, labium and maxilla, ventral view, **(c)** Labium and maxillae, ventral view, **(d)** Eyes, dorsal view, **(e)** Abdomen, ventral view (arrow indicates the circular patch with stiff setae), **(f)** Leg III, prolateral view, **(g)** spermathecae, dorsal view. Scale bars = 1 mm.

Figure 6. ***Tmesiphantes intiyaykuy*** **sp. nov., habitat at type locality.**

Table III. ***Tmesiphantes intiyaykuy*** **sp. nov. Male holotype. Length of legs and palpal segments.**

	Leg I	Leg II	Leg III	Leg IV	Palp
Femur	6.16	5.63	5.08	6.08	4.08
Patellae	3.15	3.31	2.06	3.19	2.55
Tibiae	4.87	4.02	3.53	5.83	3.38
Metatarsus	4.33	3.66	4.56	7.55	-
Tarsus	2.87	2.58	2.72	3.53	1.36
Total	21.38	19.20	17.95	26.18	11.37

Table IV. ***Tmesiphantes intiyaykuy*** **sp. nov. Female paratype. Length of legs and palpal segments.**

	Leg I	Leg II	Leg III	Leg IV	Palp
Femur	6.01	5.54	5.35	6.01	5.40
Patellae	3.70	3.47	3.03	3.66	2.68
Tibiae	4.57	3.71	3.32	4.58	2.95
Metatarsus	2.78	3.28	3.78	5.50	-
Tarsus	2.60	2.39	2.31	2.52	2.40
Total	19.66	18.39	17.79	22.27	13.43

variation makes difficult to achieve any decision regarding their phylogenetic position. The new species described in the present work, *Tmesiphantes intiyaykuy* sp. nov. and *T. caymmii* are sister groups supported by the presence of a circular patch with stiff setae on midventral abdomen and this relation was supported in all trees (Fig. 1).

This close relation was not expected given the geographic distribution of clades and species (Fabiano-da-Silva et al. 2019). The distance among these two species is about 3,600 km and they occupy very distinct habitats,

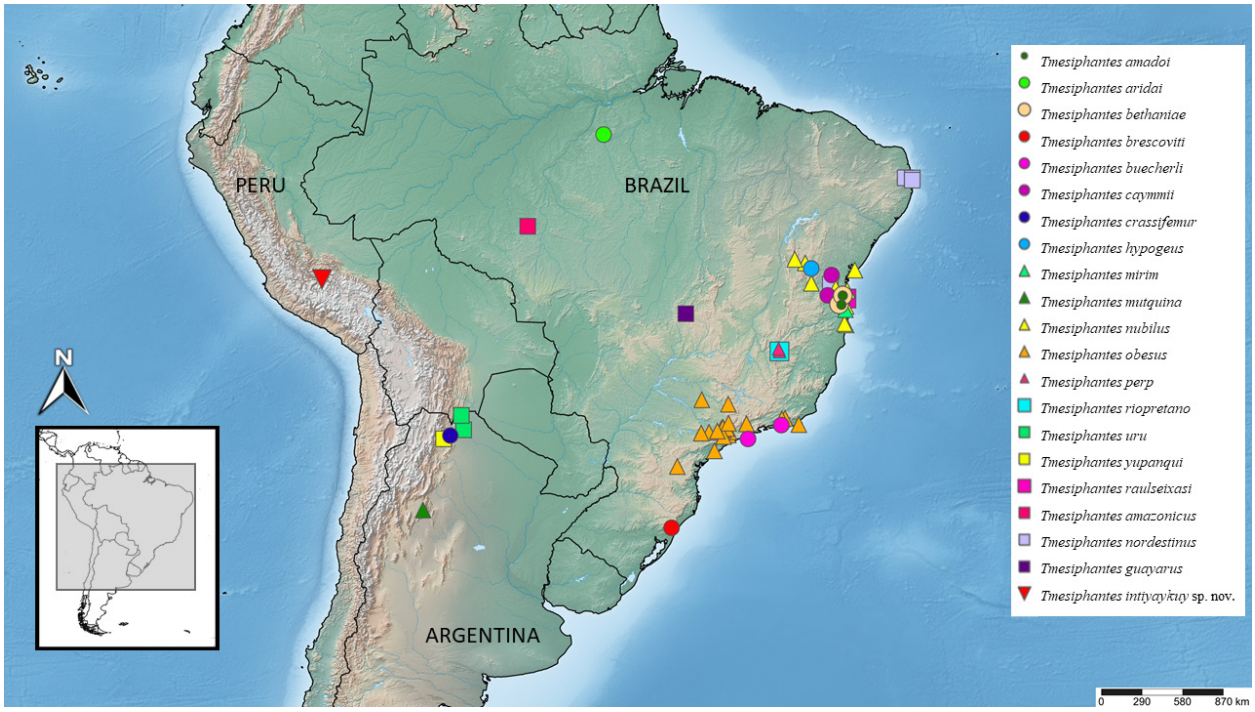

Figure 7. Distribution map for *Tmesiphantes* species.

for example, *T. caymmii* inhabit Caatinga and Atlantic forest of eastern Brazil and *T. intiyaykuy* sp. nov. is known from Inter-Andean dry forest in Peru. Regarding the geographic distribution of clades, it is expected that *T. intiyaykuy* sp. nov. could be related to the Argentinean Yungas/Andes Altitude clade formed by *Tmesiphantes crassifemur*, *T. yupanqui*, *T. mutquina* and *T. uru* at about 1,600 km distant (Fabiano-da-Silva et al. 2019). However, a similar situation is found in the clade of these taxa since its sister species, *T. mirim* occurs more than 3,000 km away in eastern Atlantic forest, Bahia state, Brazil. This remarkable disjunct geographic distribution highlights that maybe the genus *Tmesiphantes* has more representatives along the Andes of southern Peru and Bolivia and a close relation to the Argentinean clade could exist, but for now there is not a geographic structure of the phylogeny for most of the species (Fabiano-da-Silva et al. 2019). A new understanding of the geographic history of the genus could be achieved by obtaining a better phylogenetic resolution within *Tmesiphantes*, but limitations in the morphological data exist (Yamamoto et al. 2007, Indicatti et al. 2008, Perafán & Pérez-Miles 2014, Fabiano-da-Silva et al. 2019). Thus, a molecular phylogenetic hypothesis together with new collecting efforts along the Andes could shed light on the relationships of the taxa and its real geographic distribution.

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MN, NEF, JCC and RCW participate in the writing of the manuscript. MN identified the species, described the specimens and wrote the early version of the manuscript; NEF identified the species, made up the plates and wrote the early version manuscript; JCC and RCW collected the specimens and reviewed the final manuscript.