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Taxonomy and systematics

Three new harvestman species of the genus *Philora* (Opiliones: Gonyleptoidea: Stygnopsidae) with comments on troglomorphisms

Tres especies nuevas del género Philora (Opiliones: Gonyleptoidea: Stygnopsidae) con comentarios sobre troglomorfismos

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Abstract

Three new species of the genus *Philora* are described: *Philora izel* sp. nov., *Philora mazateca* sp. nov. and *Philora nympa* sp. nov. Two of these, *P. izel* and *P. nympa* exhibit remarkable troglomorphisms (adaptations to life in caves), such as depigmentation, absence of eyes and elongation of appendages. These conditions are discussed and their occurrence is compared with the other 3 species of the genus that do not exhibit troglomorphisms. A dichotomic key to identify the 5 known species of the genus is provided.

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Keywords: Laniatores; Diversity; Taxonomy; Troglomorphisms

Resumen

Se describen 3 especies nuevas del género *Philora*: *Philora izel* sp. nov., *Philora mazateca* sp. nov. y *Philora nympa* sp. nov. Dos de estas especies, *P. izel* y *P. nympa* exhiben notables troglomorfismos (adaptaciones para la vida en cuevas), tales como decoloración, ausencia de ojos y elongación de los apéndices. Se discuten estas condiciones y su presencia y se comparan con las 3 especies del género restantes, las cuales no presentan estas características. Se provee una clave para la identificación de las 5 especies del género.

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Palabras clave: Laniatores; Diversidad; Taxonomía; Troglomorfismos

Introduction

The North American harvestman genus *Philora* Goodnight and Goodnight, 1954 is comprised of 2 remarkable species with scutum completum and low tarsal count 2(1):2(1):4:4 (Cruz-López & Francke, 2013b), characters that are unusual within suborder Laniatores (Sharma & Giribet, 2011). These

characters are also present in Sandokanidae, *Heteropachylus inexpectabilis* (Soares & Soares, 1946) and presumably in *Paralola buresi* Kratochvíl, 1951 (Mendes, 2011; Sharma & Giribet, 2009; Ubick, 2007). The genus *Philora* was recently revised, rediagnosed and transferred from *incertae sedis* within Laniatores to the familial assignment in Stygnopsidae (Cruz-López & Francke, 2013b). Cruz-López and Francke (2013b) also discussed the morphological similarities in male genitalia present in *Paramitraceras* Pickard-Cambridge, 1905, *Philora*, and *Troglostygnopsis anophthalma* Šilhavý, 1974, describing the *Paramitraceras*-pattern among Stygnopsidae (Cruz-López & Francke, 2013b). Subsequently, Kury and Villarreal (2015)

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Table 1

Measurements of *P. izel* sp. nov., *P. mazateca* sp. nov., and *P. nympa* sp. nov. Abbreviations: ScL = scutum length, ScW = scutum width at mesotergal area I level, ChH = cheliceral hand height.

		Trochanter	Femur	Patella	Tibia	Metatarsus	Tarsus
<i>P. izel</i>	Pedipalp	0.23	1.00	0.40	0.76	–	0.66
ScL 2.66	LI	0.21	0.96	0.33	0.66	0.71	0.50
ScW 1.73	LII	0.26	1.23	0.48	0.96	1.00	0.93
ChH 0.98	LIII	0.30	1.10	0.38	0.83	0.88	0.53
	LIV	0.36	1.40	0.53	1.10	1.30	0.60
<i>P. mazateca</i>	Pedipalp	0.26	0.70	0.33	0.46	–	0.43
ScL 2.33	LI	0.21	0.86	0.33	0.60	0.63	0.48
ScW 1.50	LII	0.26	1.06	0.45	0.81	0.86	0.71
ChH 0.71	LIII	0.23	0.96	0.33	0.73	0.73	0.46
	LV	0.30	1.23	0.43	1.00	1.20	0.46
<i>P. nympa</i>	Pedipalp	0.23	0.86	0.40	0.60	–	0.66
ScL 2.60	LI	0.26	2.00	0.63	1.40	1.80	1.23
ScW 1.53	LII	0.70	3.40	0.96	2.53	2.73	2.93
ChH 0.96	LIII	0.40	2.70	0.63	1.76	2.56	1.13
	LIV	0.43	3.50	0.83	2.53	3.95	1.26

proposed the first penial setae homology assessment among Gonyleptoidea (Kury & Villarreal, 2015). In that work, the authors described 5 groups of setae based on topological criteria; with respect to Stygnopsidae, these groups were recognized in *Hoplobunus boneti* (Goodnight & Goodnight, 1942), *Karos* sp. and the genera with the *Paramitraceras*-pattern (Kury & Villarreal, 2015). Recently, Cruz-López and Francke (2015) based on a cladistics analysis, recognized that all members with the *Paramitraceras*-pattern form a clade, supported by synapomorphies related to characters from the penis, and formally recognized the *Paramitraceras* genus-group (Cruz-López & Francke, 2015).

Recent collecting trips to the states of Oaxaca and Puebla, Mexico, produced some specimens of 2 epigeal and 1 cavernicolous new species of *Philora*, described in the present work. One of the epigeal species and the cavernicolous species show remarkable troglomorphisms, i.e. morphological adaptations associated with life underground, illustrated and discussed below. Additionally, a taxonomic key is provided to identify the 5 known species of *Philora*.

Materials and methods

The material examined is deposited in the Colección Nacional de Arácnidos (CNAN), UNAM, Mexico. Color images were taken with a Nikon Coolpix S10 VR camera adapted to fit in a Nikon SMZ645 stereoscopic microscope. Drawings were made in Photoshop CS5 software, using assembled photographs to delineate the structures. All plates were edited using the previously mentioned version of Photoshop. Measurements are in mm. External morphology nomenclature was modified from Cruz-López and Francke (2013b) and Kury (2014). Abbreviations: ChH = cheliceral hand height, ScL = scutum length, ScW = scutum width at mesotergal area I. Genitalic nomenclature according to Kury and Villarreal (2015). The distribution map was generated using the Mapa Digital de México to desktop software, ver. 6.0.1, using geographic information from WMS service on-line (<http://gaia.inegi.org.mx/NLB/mdm5.wms>).

Descriptions

Preliminary considerations, genital nomenclature modifications

Cruz-López and Francke (2013b) described the *Paramitraceras*-pattern, present in at least *Paramitraceras*, *Philora* and *Troglostygnopsis* (Šilhavý, 1974). These authors recognized the position pattern in all macrosetae in pars distalis, named 3 setal groups: dorso-lateral or mesal, laterobasal and ventral microsetae.

Kury and Villarreal (2015) proposed the first hypothesis of homology in macrosetae in Gonyleptoidea. They described 5 setal groups according to topological criteria. Kury & Villarreal identified these groups in *Hoplobunus boneti*, *Karos* sp. and the genera with *Paramitraceras* pattern. According to Kury and Villarreal (2015), setal group C is: “short, grouped subapically (as in the *Paramitraceras-Troglostygnopsis* complex)”, “no common pattern for family is discernible other than the number of 2 pairs C1-C2 and the subdistal insertion.” We adopt herein the hypothesis and nomenclature of Kury & Villarreal, but we consider that setal group C is not recognizable at least in *Philora*. Group C is easily recognizable in *Paramitraceras* as a transversal row along the lateral margin of pars distalis, sometimes almost touching E2 setae (Cruz-López & Francke, 2012: figs. 13–15; Cruz-López & Francke, 2013a: figs. 25–27, 37–39); in *Troglostygnopsis* these setae are found as a small transversal row of 3 spiniform setae, differing from spatular macrosetae in the A + B groups (Cruz-López & Francke, 2013b: figs. 49, 52). Therefore, in *Philora* the lateral macrosetae of penis are herein considered as a complex formed by the A + B groups, the 2 ventral pairs conform the E group, and 1 pair of a small D1 setae are present. Cruz-López and Francke (2013b) showed the small D1 setae in *P. quetzalzin* (Cruz-López & Francke, 2013b: figs. 28, 31), but they did not describe or mention these setae. For the present contribution, a cursory examination of male genitalia of *P. tuxtlae* exposed the presence of D1 setae, with the same size and position as the other species of the genus described herein.

Identification key to the species of *Philora*.

- 1. Color pale cream; legs noticeably elongated, femur IV > 3.4 mm, tarsus II > 2.90 mm (Fig. 13; Table 1) *Philora nympa* sp. nov.
- 1'. Colored dark brown or orange; legs not elongated, femur IV < 1.5 mm, tarsus II < 1.00 mm (Figs. 1, 7; Table 1) 2
- 2. Body and legs light orange in color; ocelli reduced in size and unpigmented, almost absent (Fig. 1) *Philora izel* sp. nov.
- 2'. Body brown in color, with median portion of mesotergal areas almost black; ocelli not reduced in size and well pigmented (Fig. 7) 3
- Dorsum covered by small rounded setiferous tubercles (Cruz-López & Francke, 2013b: figs. 17–19) *P. quetzalzin*
- 3'. Dorsum finely granulated; blunt setiferous tubercles only in mesotergal area V and free tergites (Cruz-López & Francke, 2013b: figs. 1–3; fig. 11A) 4
- 4. Dorsoapical spiniform setiferous tubercle on metatarsus IV distinctly apical (Cruz-López & Francke, 2013b: fig. 7); with 2 sets of macrosetae A + B, 1 meso-apical with 3 setae, the other at the base of glans, with 3 setae (Cruz-López & Francke, 2013b: figs. 12, 13) *P. tuxtlae*
- 4'. Dorsoapical spiniform setiferous tubercle on metatarsus IV distinctly sub-distal (Fig. 4F); with 2 sets of macrosetae A + B, the meso-apical with 4 setae, the other at the base of glans, with 4 setae (Fig. 12) *Philora mazateca* sp. nov.

***Philora izel* sp. nov.** (Figs. 1–6)

Diagnosis

This species differs from all others by the presence of the following characters: light orange color (Fig. 1), uniform throughout body and appendages; eyes very reduced and unpigmented; ocularium strong, with the base very wide, anterior face swollen; surface of prosoma posterior to ocularium raised, forming a dome (Fig. 2D).

Description of male holotype. Dorsum: base of ocularium very wide, anterior face swollen, apex forming a small tip, pointing anteriorly. Surface of prosoma posterior to ocularium elevated, forming a dome (Fig. 2D). Eyes very reduced and unpigmented. Prosoma smooth, ocularium covered with

few, small, scattered tubercles; mesotergal areas finely granular, with few, small scattered tubercles, stand out on area I (Figs. 2, 5A). Venter: all surface covered by tubercles, on coxae I and II with long spiniform setiferous tubercles; 4 setiferous tubercles on stigmatic area, blunt and contiguous, just behind coxa IV (Fig. 5B). Chelicera: basichelicerite short, bulla well marked with distinct constriction, with 2 acute spiniform teeth,



Figure 1. *Philora izel* sp. nov. A, B, male holotype habitus, dorsal and lateral views.

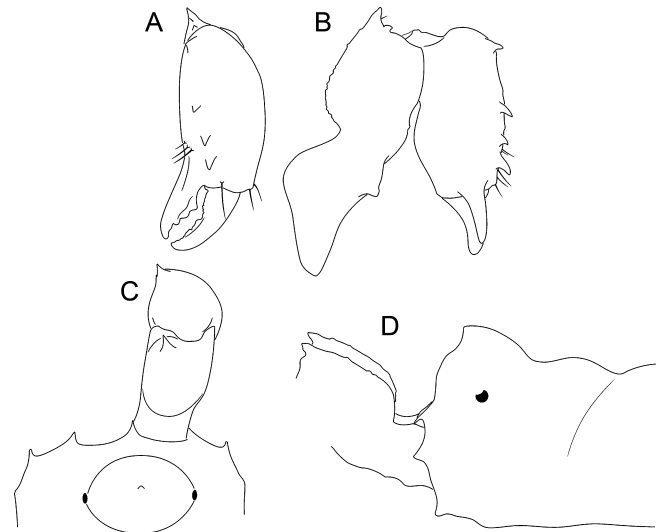


Figure 2. *Philora izel* sp. nov. Male holotype: A, B, chelicera, frontal and mesal views. C, D, carapace, dorsal and lateral views.

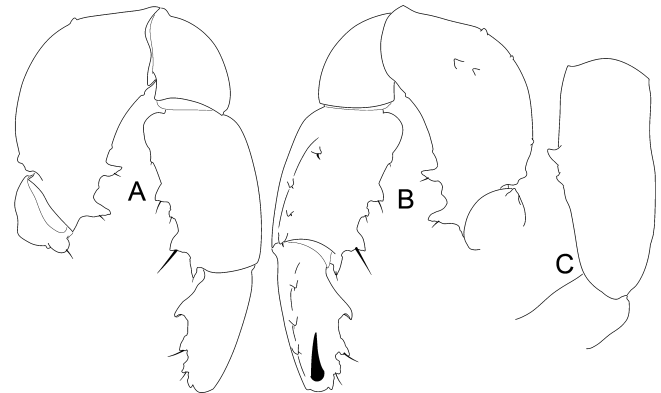


Figure 3. *Philora izel* sp. nov. Male holotype: A, B, pedipalp, ectal and mesal views. C, pedipalp femur, dorsal view.

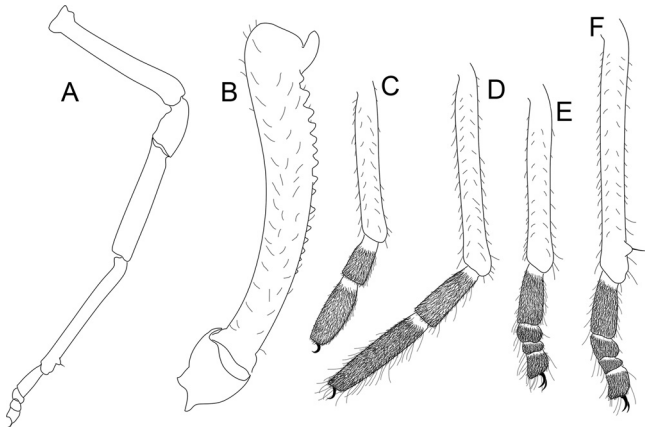


Figure 4. *Philora izel* sp. nov. Male holotype, legs: A, leg IV ectal view. B, femur IV prolateral view. C–F, metatarsus and tarsus, lateral views, legs I–IV.

1 dorso-apical and 1 ventral, just behind notch of bulla; cheliceral hand slightly swollen medially, with 4 spiniform tubercles and few spiniform setae on frontal side; cheliceral fingers: fixed finger with 3 blunt teeth, decreasing in size toward the apical portion, movable finger with basal serrula and 2 small teeth in the middle (Fig. 2A, B). Pedipalp: femur hardly convex dorsally, mesal face feebly concave, ventral face reduced, basally with 2 large setiferous tubercles, these tubercles with strong spiniform sockets, and small sub-apical seta; patella cylindrical, without noticeable ornamentation; tibia quadrangular in cross-section, internal face slightly concave, with rounded projection at the base of ectal border, both edges with 4 setiferous tubercles, similar to those ventrally on femur; tarsus tapering distally, with 3 setiferous tubercles each on ectal and mesal edges (Fig. 3). Male genitalia: lateral margins of pars distalis rolled dorsally, apical margin with 2 paramedian lobes pointed dorsally. 9 pairs of macrosetae A + B forming 2 irregular row across the lateral margin of pars distalis, latero-basally to glans. D1 setae not

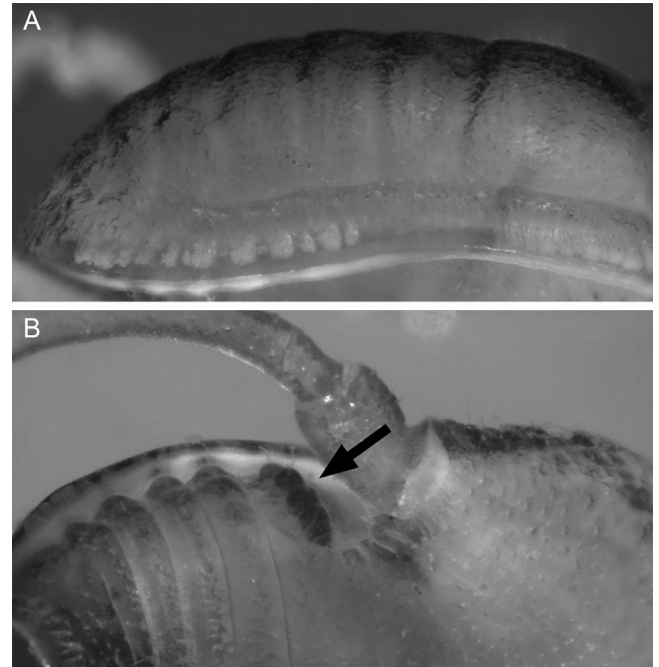


Figure 5. *Philora izel* sp. nov. Male holotype. A, dorsal ornamentation. B, setiferous tubercles on stigmatic area.

visible. Setae E ventral subapically, E1 slightly above of E2. Lobes of dorsal bilobular projection with dotted apices (Fig. 6).

Female. Unknown.

Distribution. Known only from the type locality (Fig. 19).

Taxonomic summary

Type data: male holotype (CNAN-T0939) from Cerro Caballero (18°08'32.28" N, 96°42'57.491" W), municipio de San José Tenango, Oaxaca, Mexico. April 10–2014 (O. Francke, J. Cruz, G. Contreras, J. Mendoza, A. Guzmán and S. Davlañtes coll.).

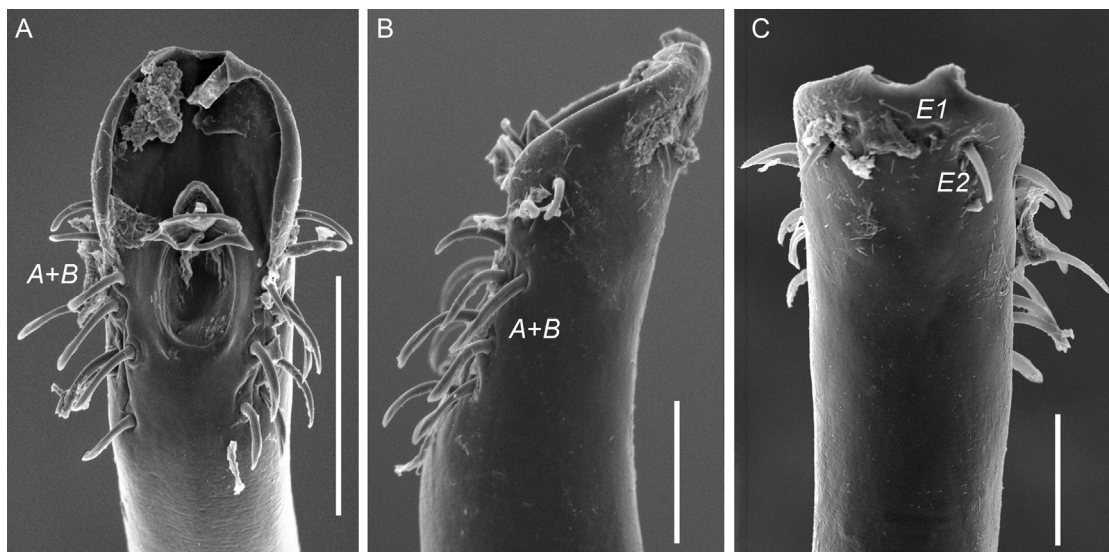


Figure 6. *Philora izel* sp. nov. Male genitalia, A, frontal view. B, lateral view. C, ventral view. Scale bars A = 100 μm, B and C = 50 μm. Setae groups A + B and E indicated.



Figure 7. *Philora mazateca* sp. nov. A, B, male holotype habitus, dorsal and lateral views.

Etymology. Specific name feminine adjective, from the Nahuatl word “izel”, meaning unique, remarkable; alluding to the unusual troglomorphisms exhibited by this presumably epigean species.

***Philora mazateca* sp. nov. (Figs. 7–12)**

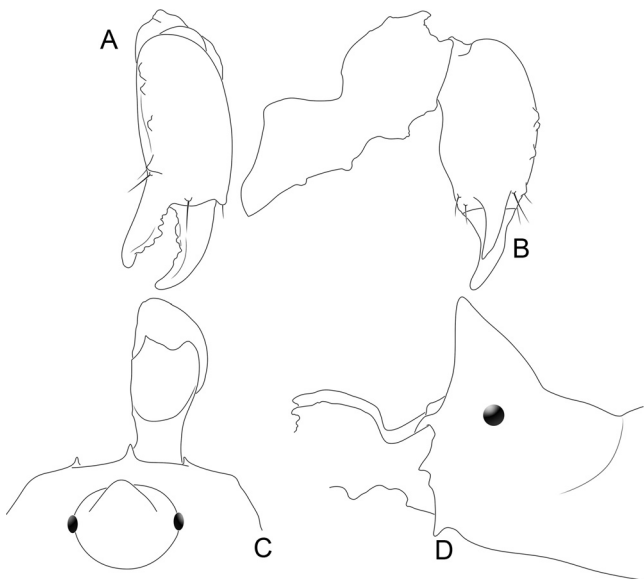


Figure 8. *Philora mazateca* sp. nov. Male holotype: A, B, chelicera, frontal and mesal view. C, D, carapace, dorsal and lateral views.

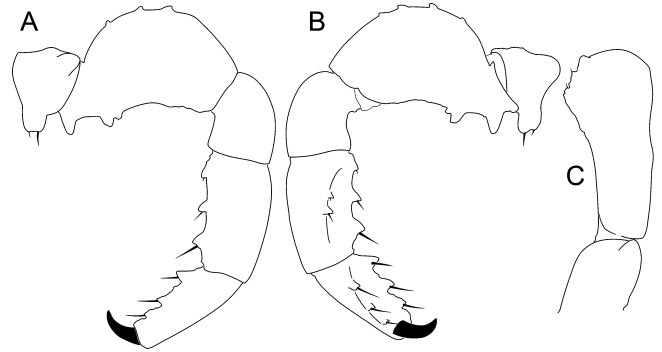


Figure 9. *Philora mazateca* sp. nov. Male holotype: A, B pedipalp, ectal and mesal views. C, pedipalp femur, dorsal view.

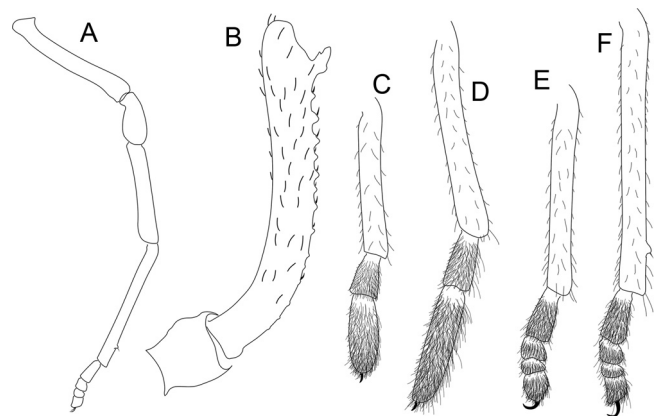


Figure 10. *Philora mazateca* sp. nov. Male holotype, legs: A, leg IV ectal view. B, femur IV prolateral view. C–F, metatarsus and tarsus, lateral views, legs I–IV.

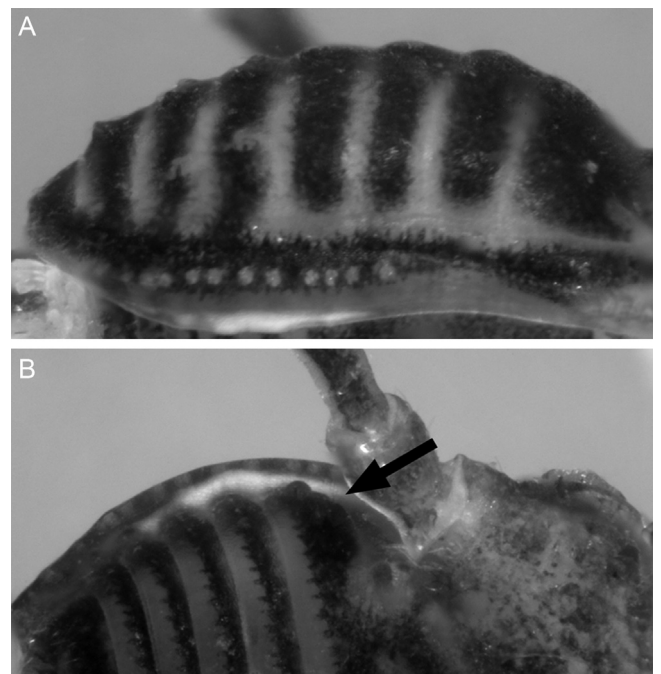


Figure 11. *Philora mazateca* sp. nov. Male holotype. A, dorsal ornamentation. B, setiferous tubercles on stigmatic area.

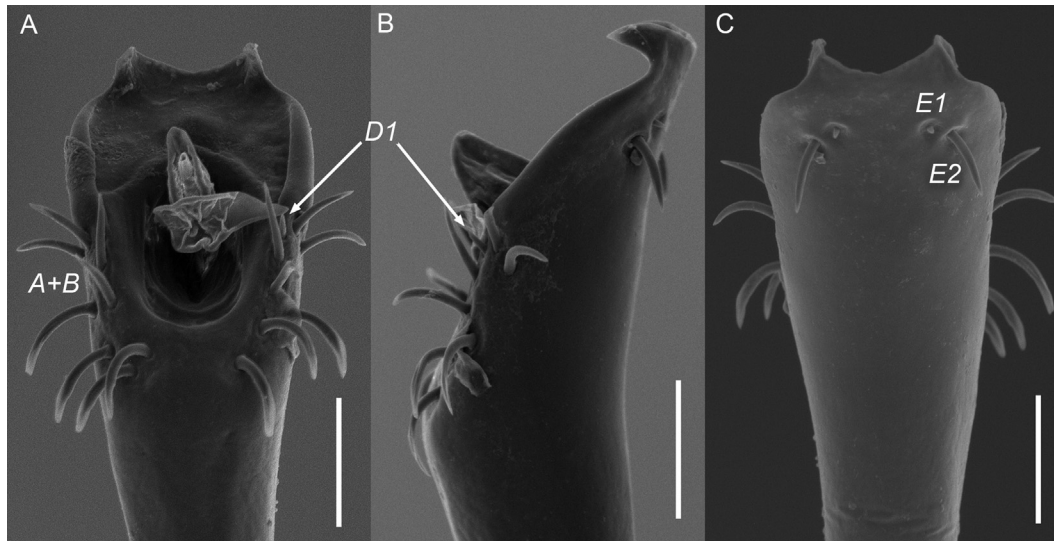


Figure 12. *Philora mazateca* sp. nov. Male genitalia: A, frontal view. B, lateral view. C, ventral view. Scale bars = 50 μ m. Setae groups A + B, E and D indicated.

Diagnosis

This species is easily recognizable from *P. izel* sp. nov. and *P. nympa* sp. nov. by the mostly bicolored body, light brown background with the reticular pattern around the margin of the scutum, central portion of mesotergal areas and on prosoma, and the ocularium very dark, almost black (Fig. 7). This species differs from *P. quetzalzin* in that the base of ocularium is not widened on *P. mazateca*, the surface of prosoma posterior to ocularium is not raised, and the dorsum is finely granular, with few scattered blunt tubercles on areas V–VII (Fig. 11A). It differs from *P. tuxtlae* in following characters: dorso-apical tubercle on metatarsus IV sub-distally rather than apically (Fig. 10F), movable cheliceral finger with small teeth rather than almost smooth (Fig. 8A) and number of macrosetae on penis.

Description of male holotype. Dorsum: ocularium conical, base elliptical, apex forming a blunt tip pointing forward; surface of prosoma posterior to ocularium not elevated. Eyes well pigmented and marked (Fig. 8). Prosoma and ocularium smooth, mesotergal areas finely granular, with blunt scattered tubercles in central portion of areas V–VIII (Fig. 11A). Venter: covered by small scattered tubercles, coxae I and II with small setiferous tubercles; 3 setiferous tubercles on stigmatic area, blunt and contiguous, just behind coxa IV (Fig. 11B). Chelicera: basiche-licerite short, bulla well marked, with distinct constriction, with 2 spiniform teeth, the dorso-apical irregular and the ventral 1 slightly distal from the notch of bulla, blunt; cheliceral hand with 4 frontal setiferous tubercles, the apical bigger, also covered by some spiniform setae; fixed finger with 3 middle teeth, blunt and contiguous, basally with small teeth and inconspicuous notches; movable finger with 2 small and contiguous median teeth, and 1 median notch, slightly distal to the teeth (Fig. 8A, B). Pedipalp: femur convex dorsally, mesal face concave, ventral area reduced, with 3 large spiniform setiferous tubercles, the 2 apical tubercles contiguous at their bases; patella cylindrical, unarmed; tibia sub-quadrangular in cross-section, with the internal face concave, ectal edge with 3 setiferous tubercles, mesal with 2, in

both edges similar to those ventrally on femur; tarsus tapering distally, with 3 setiferous tubercles on each edge (Fig. 9). Male genitalia: paramedian lobes of apical margin long and rounded, pointed dorsally. Apical margin concave. 7–8 setae A + B forming an irregular group, 3–4 of them surrounding small D1 setae, the remaining in the base of pars distalis. Setae E subapically, both pairs noticeably separated between them, E1 slightly above of E2. Lobes of dorsal bilobular projection wide, with dotted apices (Fig. 12).

Female paratype. Very similar to male, recognizable only by the absence of 4 ventral light-colored pointed areas (Cruz-López & Francke, 2013b).

Distribution. Known only from the type locality and 1 nearby locality (Fig. 19).

Taxonomic summary

Type data: male holotype (CNAN-T0940) 600 m from Pozo de Águila (18°11'51.792" N, 96°40'36.552" W), Municipio de San José Tenango, Oaxaca, Mexico. April 11–2014 (O. Francke, J. Cruz, G. Contreras, J. Mendoza, A. Guzmán and S. Davlañtes coll.). 3 female and 1 juvenile paratypes (CNAN-T0941) same data as holotype.

Other material examined: female DNA voucher (DNA-Op0046) from Cerro Caballero (18°08'8.88" N, 96°41'22.92" W), Municipio de San José Tenango, Oaxaca, Mexico. September 30–2008 (J. Cruz coll.).

Etymology. The specific name is feminine, a noun used in apposition, derived from the Spanish word “mazateca”, a demonym which refers to the Mexican ethnic group that lives in the region of the type locality.

Philora nympa sp. nov. (Figs. 13–18)

Diagnosis

This species is easily recognizable from all the other members of the genus by the following characters: general pale white

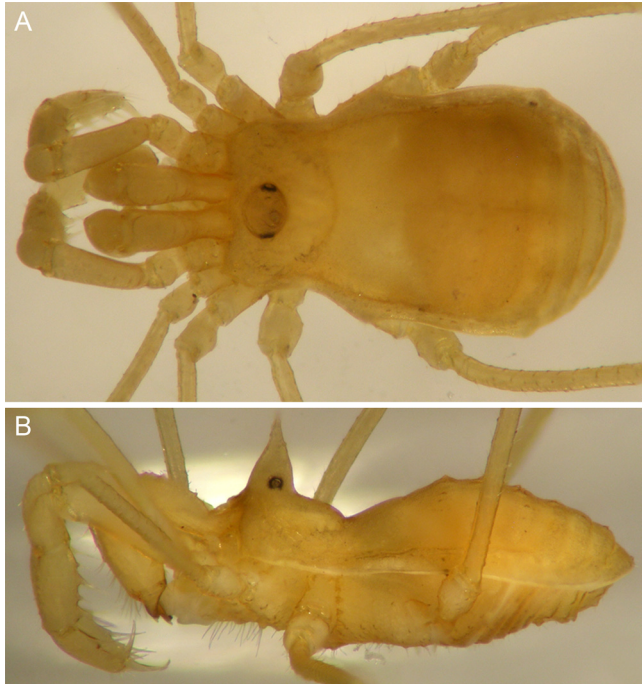


Figure 13. *Philora nympha* sp. nov. A, B, male holotype habitus, dorsal and lateral views.

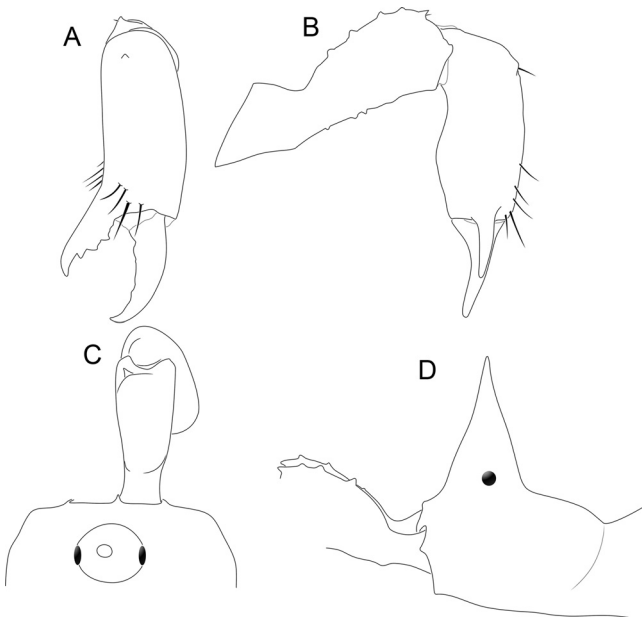


Figure 14. *Philora nympha* sp. nov. Male holotype: A, B, chelicera, frontal and mesal views. C, D, carapace, dorsal and lateral views.

color throughout body and appendages (Fig. 13); basichelicerite, pedipalp, pedipalpal armature and legs very long (Figs. 14–16), femur IV >3.4 mm, tarsus II >2.90 mm.

Description of male holotype. Dorsum: ocularium conical, elongated and finely acute in the apex, pointing dorsally; surface of prosoma posterior to ocularium slightly elevated; eyes well marked and pigmented; prosoma and ocularium smooth, mesotergal areas finely granular, with a central row of small setiferous tubercles on areas II–VII (Figs. 14C, D, 17A). Venter:

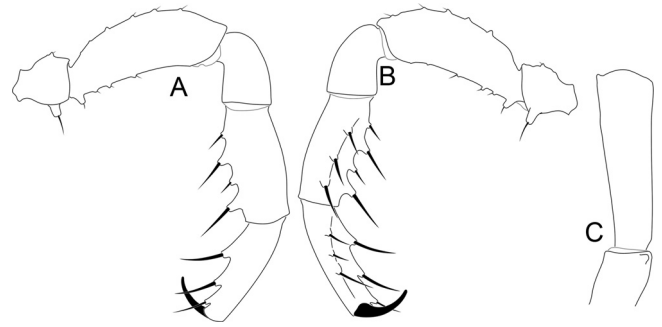


Figure 15. *Philora nympha* sp. nov. Male holotype: A, B, pedipalp, ectal and mesal views. C, pedipalp femur, dorsal view.

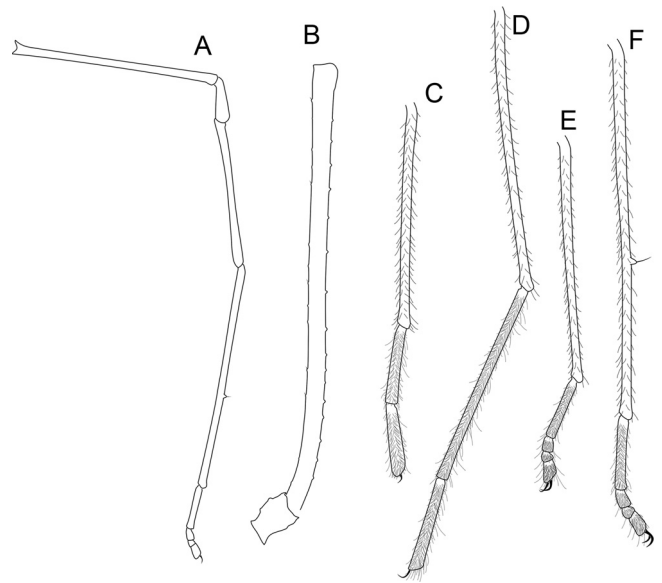


Figure 16. *Philora nympha* sp. nov. Male holotype, legs: A, leg IV ectal view. B, femur IV prolateral view. C-F, metatarsus and tarsus, lateral views, legs I-IV.

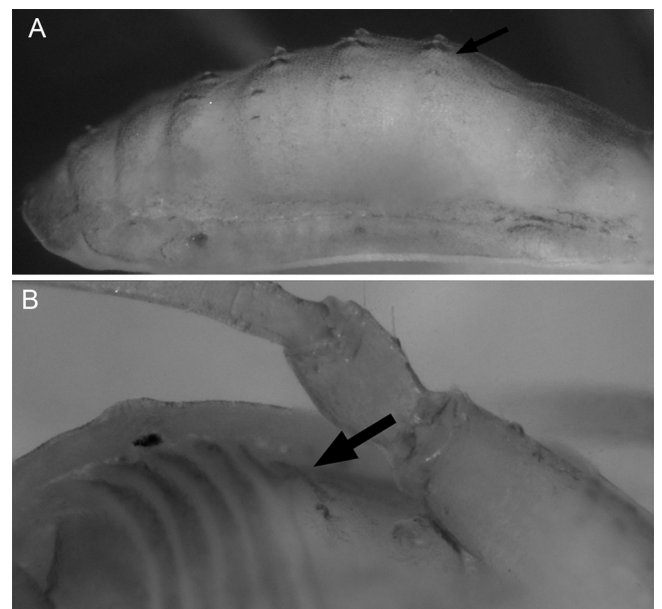


Figure 17. *Philora nympha* sp. nov. Male holotype. A, dorsal ornamentation. B, setiferous tubercles on stigmatic area.

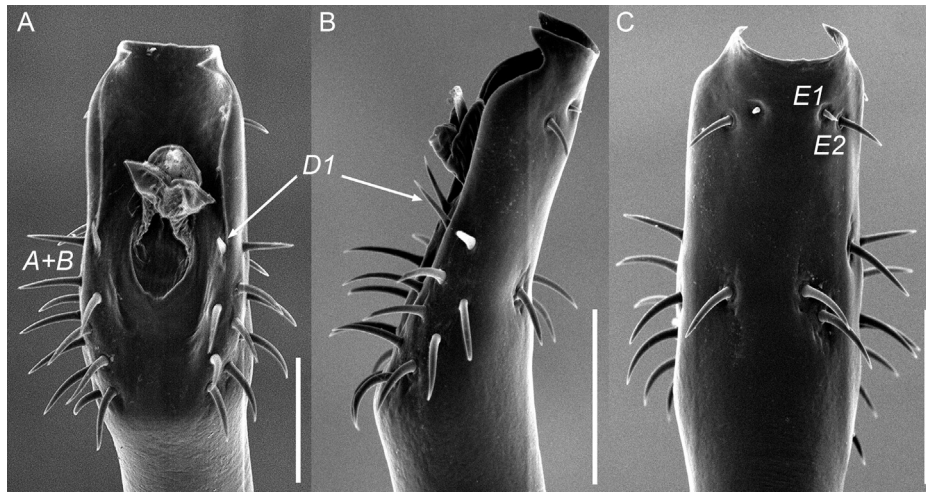


Figure 18. *Philora nympha* sp. nov. Male genitalia: A, frontal view. B, lateral view. C, ventral view. Scale bars = 100 μ m. Setae groups A + B, E and D indicated.

covered by small scattered tubercles; coxae I and II with long, spiniform setiferous tubercles, these tubercles with the apical setae very long; with 3 setiferous tubercles behind coxa IV, 2 of them very wide and fused, giving blunt dome appearance (Fig. 17B). Chelicera: basichelecerite elongated, bulla subtly marked with shallow constriction, extending more than 3 fourths of the basichelecerite length, dorsoapical spiniform tooth small, ventral absent; cheliceral hand covered only with spiniform setae, near the cheliceral fingers; fixed finger with 4 middle teeth, contiguous, central pair more developed; movable finger with small basal tooth, and serrula covering almost entire length (Fig. 14A, B). Pedipalp: femur quadrangular in cross-section, ventrally with 4 small setiferous tubercles, scattered along the entire length; patella without remarkable ornamentation; tibia quadrangular in cross-section, mesal edge with 3 spiniform setiferous tubercles, ectal with 4; tarsus tapering distally, with 4 setiferous tubercles on each edge; all setae of pedipalpal armature inserted apically on the tubercle, rather than

subdistally (Fig. 15). Male genitalia: paramedian lobes acute apically, pointed dorso-internally. With 11–12 A + B setae, forming 2 longitudinal rows, the dorsal row along the lateral margin, the ventral row from the base of pars distalis to ventral position, below to E setae. D1 setae long, in the inner side of lateral margin. E1 setae slightly apical to E2. Lobes of dorsal bilobular projection triangular shape, with dotted apices (Fig. 18).

Female paratype. Very similar to male, barely distinguishable by the absence of 4 ventral light-colored pointed areas (Cruz-López & Francke, 2013b).

Distribution. Known only from the type locality (Fig. 19).

Taxonomic summary

Type data: male holotype (CNAN-T0942) from Chupa Cave (18°18'55.728" N, 96°52'4.908" W), Municipio de Tequixtepec, Puebla, Mexico. March 12-2014 (L. Bouchard, M. Archambault coll.). 2 female paratypes (CNAN-T0943) with same data as holotype.

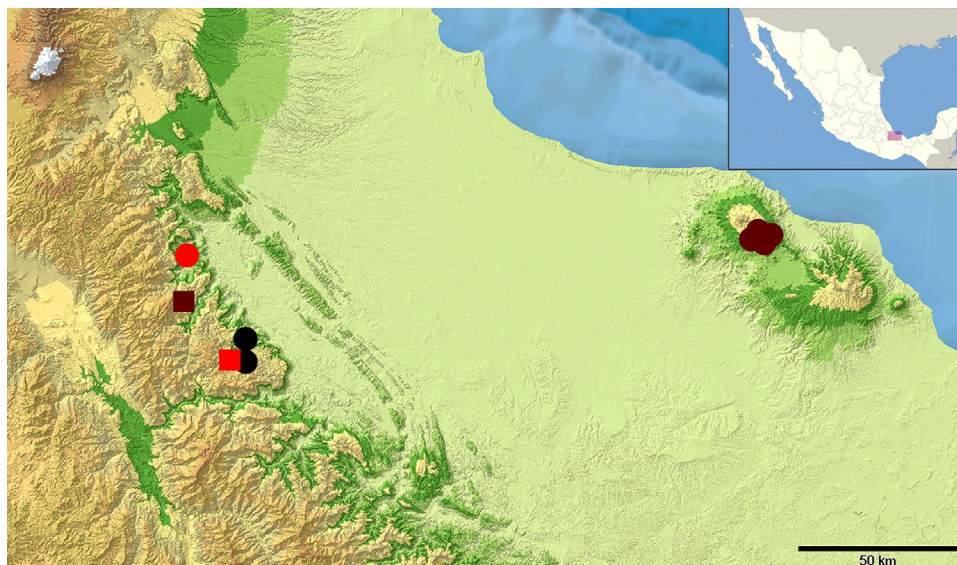


Figure 19. Distribution map of the species of *Philora*. *Philora tuxtlae* purple circles, *P. quetzalzin* red circle, *P. izel* sp. n. red square, *P. mazateca* sp. n. black circles, and *P. nympha* sp. n. purple square.

Etymology. Specific name is feminine, a noun in apposition derived from the Greek word “νύμφα” (nymph), in reference to minor divinities in Greco-Roman culture and often represented as beautiful maidens. It was believed that they sometimes lived inside caves.

Discussion

The epigeal species *P. quetzalzin*, *P. mazateca* and *P. tuxtlae* have the cryptic coloration of the body, with background color brown with dark areas. This color pattern plus thanatotic behavior suggest specific habits to life in leaf litter, which is where these species have been retrieved from (Cruz-López & Francke, 2013b). On the other hand, *P. izel* exhibits light orange color, uniform in all body and appendages, and reduced and unpigmented eyes, characters usually correlated with cavernicolous habits (Christiansen, 2012), even though the single known specimen was collected on the surface under a large rock and not inside a cave. However, it is known that some epigeal species of harvestmen exhibit light color body, eye reduced or lost, and occasionally legs elongation (González-Sponga, 1997; Kauri, 1989; Pérez-González & Kury, 2007; Pinto-da-Rocha & Kury, 2003). These characters have been associated to the specific ecological niche of these species, which might have similar light and humidity conditions to those found in caves, although this hypothesis has not been tested.

Even though *P. izel* and *P. mazateca* are from the same type locality, the specimens of *P. mazateca* were collected by sifting leaf litter, a technique previously used to collect epigeal *P. tuxtlae* (Cruz-López & Francke, 2013b). The holotype of *P. izel* was found by chance inside a small pit in a deeply buried rock, similar micro-habitat to that of the ricinuleid *Pseudocellus cruzlopezi* Valdez-Mondragón & Francke, 2013 (Valdez-Mondragón & Francke, 2013). Further studies are needed to determine if the “troglomorphisms” in *P. izel* are due to environmental conditions of its particular ecological niche, or perhaps the male wandered outside a hidden cave through a small crevice in search of mates.

The cavernicolous *P. nymphea* exhibits typical troglomorphic characters: pale color and remarkably long legs, and incredibly delineated and pigmented eyes. The type specimens were found walking in the walls of cave (collectors label) so that, the long legs could represent an adaptative change from inhabiting leaf litter to a wandering habit inside the cave.

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