

A new species of *Typhlomyrmex* from Colombia, re-description of the worker of *T. clavicornis* Emery, description of the worker of *T. prolatus* Brown, and key of known species (Hymenoptera, Formicidae)

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Abstract

Typhlomyrmex Mayr is a genus of small and cryptic ants of the subfamily Ectatomminae. Here, we provide taxonomic notes on the ants of the genus *Typhlomyrmex* Mayr from Colombia, along with the description of *Typhlomyrmex encanto* sp. nov. based on the worker caste, and the re-description / description of the worker caste of *T. clavicornis* Emery and *T. prolatus* Brown. Finally, we offer a key for the known species of *Typhlomyrmex*, and distribution maps for the three species this study focuses on.

Keywords

Ectatomminae, Neotropics, Subterranean ants, TSBF method, Wallacean Shortfall

Introduction

The relatively small genus *Typhlomyrmex* Mayr, belongs to the subfamily Ectatomminae, consists of 10 strictly Neotropical extant species. Camacho et al. (2022) explored the internal phylogeny of the Ectaheteromorph clade, sensu (Bolton 2003), and offered a new

classification of this group with a single subfamily (Ectatomminae) consisting of two tribes, Ectatommini and Heteroponerini. Within the Ectatommini tribe, *Typhlomyrmex* is redefined to contain the species *T. clavicornis*, *T. foreli*, *T. major*, *T. meire*, *T. prolatus*, *T. pusillus*, and *T. rogenhoferi* (Brown 1965; Lacau et al. 2004); in addition, the species *T. lavra*, *T. lenis*, and *T. reichenspergeri* are transferred to the genus from *Gnamptogenys* Roger (Camacho et al. 2022). In the new sense, Camacho et al. (2022) define *Typhlomyrmex* as ants with the following characteristics: a sometimes-well-defined antennal club, consisting of 3 or 4 segments; cephalic vertex mostly smooth and shining; eyes absent or reduced, promesonotal suture well marked, totally interrupting dorsal mesosomal sculpture; metacoxal dorsum unarmed or with small lobe or denticle and petiole pedunculate, sometimes with a prominent anteroventral process, among other traits.

Typhlomyrmex species are cataloged as ants with poorly known ecology and biology, owing to them nesting in decomposed wood and soil (Lacau et al. 2008), substrates that are usually under-sampled in traditional samplings while surveys more focused on subterranean and soil nesting ants have proven to be more effective in capturing numerous species (Castro et al. 2018b). Therefore, though *Typhlomyrmex* presents a wide distribution (Mexico to Argentina), this genus does not present high abundances and species richness in robust inventories (Wilkie et al. 2010; Franco et al. 2019; Dáttilo et al. 2020; Meurgey and Ramage 2020; Albuquerque et al. 2021).

Of the 10 known *Typhlomyrmex* species, the worker caste of *T. clavicornis*, *T. foreli* and *T. prolatus*, are not known or briefly described. In this publication, the worker of *T. clavicornis* are re-described and the worker of *T. prolatus* described, along with *Typhlomyrmex encanto* sp. nov. from Colombia, likely the smallest species known of Ectatomminae. A key to all species known based on the worker caste is offered, as well as distribution maps for the three species reviewed in this manuscript.

Materials and methods

The material examined is deposited at Instituto Humboldt, Claustro San Agustín, Villa de Leyva, Boyacá, Colombia (**IAvH**); Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá D.C., Colombia (**ICN**); Laboratorio de Entomología of the Universidad de la Amazonia, Florencia, Caquetá, Colombia (**LEUA**) and Colección de artrópodos terrestres de la Amazonia Colombiana, Instituto SINCHI, Leticia, Amazonas, Colombia (**CATAC**).

Imaging

Observations, descriptions, measurements, and photographic images of the pin-pointed specimens were obtained with a Nikon SMZ25 stereomicroscope and DS-Ri2 camera with NIS Elements software at the New Jersey Institute of Technology. All images are digitally stacked photomicrographic composites of several individual focal planes, which were obtained using Nikon Elements software. The distribution maps were created using ArcGIS desktop ver. 10.8 (ESRI, Redlands, CA).

Measurements and indices

All measurements were taken using an ocular micrometer at 80× magnification on a Nikon SMZ25 microscope and corroborating with measurements using the NIS Elements software. Morphometric sampling included linear measurements of 8 morphological traits: three cephalic, two mesosomal and three petiolar (Table 1). All measurements are given in millimeters. Measurement protocols follow those commonly used in ant systematics and in previous taxonomic reviews of *Typhlomyrmex* (Lacau et al. 2004).

Table 1. Morphological variables used in morphometric analyses.

HL	Head length. In full-face view, maximum distance from the posterior margin of head to the anterior margin of clypeus (Suppl. material 1: fig. S1A).
HW	Head width. In full-face view, maximum width of head, excluding the eyes (Suppl. material 1: fig. S1A).
SL	Scape length. In frontal view, maximum length of scape excluding basal condyle and neck (Suppl. material 1: fig. S1A).
PrW	Pronotum width. In dorsal view, maximum width of pronotum (Suppl. material 1: fig. S1B).
WL	Weber's length. In lateral view, distance between the anterior margin of the pronotum, excluding collar, to the posteroventral margin of metapleuron (Suppl. material 1: fig. S1C).
PeW	Petiolar width. In dorsal view, maximum width of petiole (Suppl. material 1: fig. S1B).
PeH	Petiolar height. In lateral view, perpendicular distance from the posteroventral lobe of petiolar tergite to its maximum dorsal margin (Suppl. material 1: fig. S1C).
PeL	Petiolar length. In lateral view, distance between the anterior margin of petiole, including its anterolateral projection, to its posterior margin, excluding the posteroventral folded ridge that embraces the helcium (Suppl. material 1: fig. S1C).
TL	Total length: Sum of HL + WL + abdominal segments A2 through A7. Segments A2 – A7 measured as PL and gaster length.
CI	Cephalic index: HW/HL
SI	Scape index: SL/HW

Taxonomy

Typhlomyrmex encanto sp. nov.

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Figs 1, 6A

Typhlomyrmex sp. A Lacau et al. 2008.

Holotype worker. COLOMBIA, Amazonas, El Encanto, 01°44'3.48"S, 73°11'57.7"W, 156 m, 14–17.iv.2022, leg. L. Pérez & R. Nova (ICN 103630).

Paratype. 1 worker, same data as holotype (ICN 103631).

Non-type material examined. COLOMBIA, Vaupés, Pacoa. Río Causuarí, Cerro Morroco, 00°08'19.2"N, 73°11'57.7"W, 195 m, 26.ii.2018, leg. D. Luna & W. Gómez, 2 workers (ICN 103632).

Worker description. *Head.* Rectangular, longer than wide. Vertex slightly concave in the middle, occipital corners rounded. Sides of head slightly convex, its greatest width towards the middle of the head. Head narrowed anteriorly. Anterior margin of the

clypeus slightly convex, with a short and prominent truncated lobe. Eyes reduced to an ommatidium towards the position of the apical third of the head; antennal sockets fully concealed by the frontal lobes; frontal lobes short and subquadrate; toruli circular, antennae 12-segmented with a well-defined 3-segmented club; scape conspicuously curved ventrally at half of its apical length in frontal view, the maximal width nearly equal to pedicel length; when folded backward, scape does not reach the vertexal margin; pedicel about as long as wide, and about as long as the 3 following segments together; segments A3 to A9 very short; segment 10 to 12 forming antennal club; mandible shape elongated-subtriangular, the apical margin joining basal margin at a strongly rounded angle; masticatory margin with a series of small teeth followed by a larger apical tooth.

Mesosoma. Lightly curved and irregular in lateral view, pronotum anteriorly rounded in dorsal view, longer than wide and strongly sloping anteriorly in lateral view, its posterior part curved, mesonotum slightly convex, promesonotal suture well marked, propodeal sutures feebly marked. Propodeal spiracle small, circular, equidistant from the dorsal and lateral margins of the propodeum, its diameter (0.012 mm) roughly equal to the length of the 8th antennomere; dorsal face of the propodeum weakly inclined and convex, gradually rounding beyond the spiracle towards the sloping posterior face; propodeal spiracle opened laterally, its large orifice bordered by a thin cuticular ring; propodeal lobes lacking.

Metasoma. Petiole in lateral view higher than long, with short and stout peduncle; its front face flat, delimited by a poorly defined carinae; dorsum strongly rounded and short. Petiole spiracle distant from the leading edge by a length greater than its diameter. Sub-petiolar process elongate and forward facing, lobe-shaped tapering to a downward point. First tergum with prora marked.

Sculpture. Body generally opaque with restricted smooth shiny areas on the mesopleura; front of head with a sculpture that is a mixture of points and uniform longitudinal striation short, faint longitudinal striation limited to the pronotum and the lower part of the sides of the propodeum, below the propodeal spiracle and partly on the propodeal bulla.

Pilosity and color. The whole body with a dense and very short pubescence. Erect hairs absent. Light brown color. Outer surface of the mid tibiae without a series of hard, spiniform hairs.

Measurements. HW 0.339, HL 0.413, SL 0.211, PrW 0.204, PeW 0.129, PeL 0.186, PeH 0.154, WL 0.488, CI 82, SI 62, TL 1.57.

Diagnosis and comments. A unique feature in *Typhlomyrmex encanto* sp. nov. is the median projection of the clypeal lamella, not known in any other described *Typhlomyrmex*. This species is also the smallest of the genus, and probably the smallest Ectatomminae in the World. In their treatment of the *Typhlomyrmex* from Colombia, Lacau et al. (2008) include one unnamed species, referred to as “sp. A” which matches the description of *Typhlomyrmex encanto* sp. nov. In the key to the species, the following characterization of species A can be obtained, translated from French: “Head capsule whose maximum width is located at half its length, with lateral surfaces clearly converging anteriorly; occipital carina absent; clypeus in dorsal view, with the anterior



Figure 1. Photomicrographs of *Typhlomyrmex encanto* sp. nov. (ICN 103630) **A** head in frontal view **B** body in dorsal view **C** body in lateral view. Scale bars: 0.2 mm (**A**); 0.5 mm (**B, C**).

edge forming a distinct constricted convexity; clypeal lamella bearing a short and narrow median process (its maximum width clearly less than that of the scape), protruding and clearly truncated at the apex; scape in dorsal view greatly enlarged posteriorly at its basal third; indistinct metanotal groove". The authors refer to material of this species from Brazil, Colombia and Peru and mention that the description is "in progress". However, this description was not published and there are no known plans to do so (Jacques Delabie, pers. comm.). Lacau et al. (2008) also mention material from Leticia, Amazonas, Colombia, was deposited in the Museum of Comparative Zoology at Harvard University (MCZ).

Distribution. This species is recorded for the Colombian Amazon and, as mentioned above, Lacau et al. (2008) reports this species also for Brazil and Peru without coordinates or collection vouchers, with the available information this species seems to be restricted to the Amazon region of South America.

Biological notes. This species was collected in leaf litter with the Winkler method, in primary rain forests with a high degree of conservation.

Etymology. This species is named in honor of the “El Encanto”, locality where the type-material was collected; Also, *encanto* is a Spanish word that means “charm”, and refers to the Disney movie *Encanto* (2021) based on Colombian culture.

Typhlomyrmex clavicornis Emery

Figs 2, 6B

Typhlomyrmex clavicornis Emery, 1906: 112. Alate queen, Bolivia.

Typhlomyrmex clavicornis var. *divergens* Forel, 1906: 248. Queen and male, Paraguay, synonymy in Brown 1965: 71.

Typhlomyrmex richardsi Donisthorpe 1939: 161. Male, Guiana. Synonymy in Brown 1965: 71.

Material examined. COLOMBIA: Caquetá, Albania, Vda. Samaria, Fca. Buenavista, 01°18'12"N, 75°52'23"W, 266 m, 26.iii.2019, leg. E. Durán, 1 worker and 1 female alate (LEUA 00000050569); Sebastopol, 01°43'00.12"N, 75°36'49.3"W, 527 m, 29.iii.2016, leg. D. Castro, 2 workers (CATAC-02562; 02563); Palmichar, 01°42'52.2"N, 75°36'53.6"W, 241 m, 23.iii.2016, leg. Y. Virguez, 1 worker (CATAC-00292); Tarquí, 01°50'36.4"N, 75°40'18.3"W, 1247 m, 5.iv.2016, leg. Y. Virguez, 5 workers (CATAC-01025); Vda. La Viciosa, CIMAZ Macagual, 01°30'23"N, 73°30'43"W, 250m, 16.vi.2019, leg. E. Durán, 1 worker and 1 female alate (LEUA 00000043623; 00000043633); Belén de los Andaquíes, 01°42'6.8"N, 75°53'57.5"W, 1500 m, 23.i.2017, leg. D. Castro, 3 workers (CATAC-00893); Morelia, Vda. Campoalegre, Fca. Buenavista, 01°19'21"N, 75°43'12"W, 257 m, 11.vi.2022, leg D. Coy, 2 workers (LEUA 00000050566; 00000050567); San José del Fragua, Bellavista, 1°19'16.21"N, 76°00'21.30"W, 504 m, 4.xii.2018, leg- M. Perez, 1 worker (CATAC-04222); Putumayo, Puerto Leguizamo, La Tagua, 00°05'14.9"S, 74°36'38.4"W 182 m, 14.vii.2016, leg. D. Castro, 1 worker (CATAC-00242).

Worker description. Head. Quadrated, as wide as long. Vertex very slightly concave, occipital corners rounded. Sides of head slightly convex, its greatest width towards one third of the vertex. Anterior margin of the clypeus slightly convex, without any type of projection or prolongation. Eyes reduced to one ommatidia situated in anterior third of the capsule sides; antennal sockets totally concealed by the frontal lobes; frontal lobes elongate and rounded; toruli circular and separated, visible by transparency through the frontal groove integument. Antennae 12-segmented with a well-defined 3-segmented club. Scapes short, and stout, their distal end at rest distant from

the vertexal margin; pedicel about twice as long as wide, and about as long as the 3 following segments together, segments A3–A9 short, much wider than long; segments 10 to 12 forming antennal club; mandibles short and subtriangular; mandibles closed do not fit completely with anterior clypeal margin, masticatory margin with a series of small teeth followed by a large long apical tooth.

Mesosoma. Subrectangular in lateral view; pronotum anteriorly rounded in dorsal view, much wider than long, strongly sloping and without a pronotal carinae; promesonotal suture well defined dorsally; mesonotum flat dorsally; metanotal groove marked distinct and marked by small carinae in profile view; anterior face of propodeum expanded, forming a rounded corner; posterior face of propodeum straight and steep; propodeal spiracle large, circular, equidistant from the dorsal and lateral margins of the propodeum, its diameter (0.062 mm) roughly equal to the length of the penultimate antennomere.

Metasoma. Petiole in lateral view higher than long, its front face flat, delimited from the lateral faces by a sharp corner. Node dorsum slightly convex and short. Petiole spiracle distant from the leading edge by a length greater than its diameter; sub-petiolar process prominent and lobe-shaped, tapering to a downward point.

Sculpture. Body generally opaque with restricted smooth shiny areas, like areas of mesopleura. Front of head with a sculpture that is a mixture of points and faint striations. Oblique longitudinal striation better marked towards the sides of the head and more visible in oblique lateral view. Short longitudinal striation limited to the lower part of the sides of the propodeal, below the propodeal spiracle and partly on the propodeal bulla.

Pilosity and color. The whole body with a dense and short pubescence. A few erect, longer hairs (length about penultimate antennomere) on dome of clypeus and back of petiole. Light brown color, whitish hairs. Outer surface of the mid tibiae with a series of hard, spiniform, erect, dark hairs, which contrast and mix with the soft, light, and ordinary hairs.

Measurements. HW 0.723, HL 0.709, SL 0.450, PrW 0.487, PeW 0.360, PeL 0.395, PeH 0.319, WL 1.01, CI 102, SI 62, TL 3.31.

Diagnosis and comments. According to Brown (1965: 71) the queens and workers of this species are distinguished by a prominent antennal club and mandibles with a long apical tooth (see Brown 1965, Fig. 4). Lacau et al. (2004) also add the presence of spiniform hairs on the mesotibiae (a feature shared with *T. meire*). Two workers examined in the CATAC collection were identified as *T. meire* (CATAC-02562; 02563), although the mesotibia have spiniform hairs and the antennae have 12 segments and not 10 (as in *T. meire*) so we do consider these workers were misidentified. *T. meire* was reported from Colombia in a previous checklist (Castro et al. 2018b) and recorded in Ant Maps, but here we identify these records as *T. clavicornis*. Brown (1965) does not mention the possession of spiniform hairs for *T. clavicornis*, a feature that he would surely have noticed, so the question remains as to what the limits of this species are. Until now, there are no valid records of *T. meire* from Colombia.

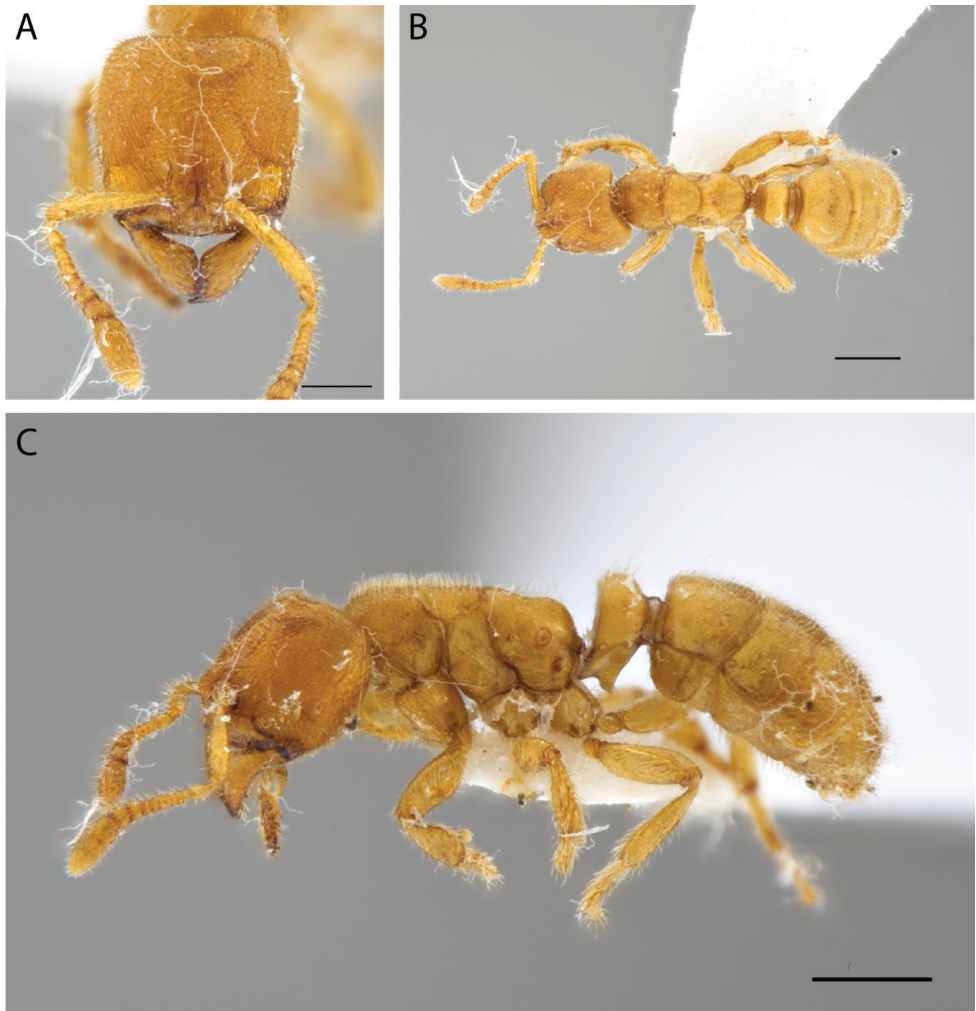


Figure 2. Photomicrographs of *Typhlomyrmex clavicornis* (CATAC-02562) **A** head in frontal view **B** body in dorsal view **C** body in lateral view. Scale bars: 0.2 mm (**A**); 0.5 mm (**B, C**).

There is little variation in the material examined, especially in the teeth of the mandibles, which can be small and uniform, of various sizes, or almost invisible (worn), but the apical tooth is always prominent. In females, the spiniform hairs of the mesotibiae are more noticeable. The metafemur appears more enlarged in the anterior view, which would explain why a specimen from LEUA (00000050566) is identified as *T. major*. However, in *T. major* this widening is abrupt after a short margin (see fig. 4C in Lacau et al. 2008), which does not occur in the LEUA specimen. On the other hand, in *T. major* the scape is slightly longer, the propodeal spiracle is smaller, the mesotibia presumably do not have spiniform hairs, and the petiole has a more visible peduncle.

Distribution. Species widely distributed in South America, with valid records in Colombia, Bolivia (type-locality), Paraguay, Guyana, and Brazil with only one record worth for the state of Rio de Janeiro (see discussion). In the literature it is also recorded for French Guyana and Surinam (Fernández and Sendoya 2004), however, no coordinates or valid records were found for this information. However, it is evident that it is a species of wide distribution, with records in the Amazon, Chaco, Cerrado and the Atlantic Forest.

Biological notes. The analyzed material was collected in soil and litter, though the species was predominantly found in deep soil strata (< 20–30 cm). The soil specimens were found at 10 cm to 30 cm depth, while they were absent in the 0–10 cm stratum; more than half of the specimens were found in the 10–20 cm stratum, and the largest number of individuals from the same sample were collected in the depth of 20–30 cm (8 individuals), while in litter only one individual per sample was found. Likewise, this species was found in different coverages, both natural and intervened, although it stands out that most occurrences were in pastures. *Typhlomyrmex clavicornis* was also collected in secondary and primary forests.

Typhlomyrmex prolatus Brown

Figs 3, 6C

Typhlomyrmex prolatus Brown, 1965: 72, fig. 6 (queen.) Costa Rica.

Typhlomyrmex prolatus: Kempf, 1972: 256; Bolton, 1995: 422; Camacho et al. 2022: 12.

Material examined. COLOMBIA: Caquetá, Belén de los Andaquíes, 01°37'40.0"N, 75°54'16.8"W, 750 m, 28.i.2017, leg. D. Castro, 2 workers (CATAC-00879); Florencia, Vereda La Viciosa, CIMAZ Macagual, 01°28'46"N, 75°36'16"W, 260 m, 26.x.2019, leg. J. Perdomo, 1 worker (LEUA 00000050568).

Worker description. Head. Elongated; vertexal margin weakly concave; posterolateral corners narrowly rounded; sides of head weakly convex; clypeus medially dome-shaped, the dome conspicuously protruding from the lateral clypeal margins and with a vertical anterior face; clypeal margin medially convex; anterior clypeal lamella narrow, without a medial lobe; eyes reduced to one ommatidia situated near the middle of the capsule sides; antennal sockets partially concealed by the frontal lobes frontal carinae; frontal lobes short and subquadrate; toruli circular and definitely separated, visible by transparency through the frontal groove integument; antenna 12-segmented with a 3 segmented club; scape conspicuously bent ventrally at one third of its apical length in frontal view, the maximal width being nearly equal to the pedicel length; when folded backward, its apex reach the vertexal margin; pedicel about twice as long as wide, and about as long as the 2 following segments together; segments A3–A9 quadrate to wider than long; segment 10 to 12 forming antennal club; mandible shape elongated-subtriangular, the apical margin joining basal margin at a round angle; masticatory margin with 7–9 small teeth from base to apex before the bigger apical tooth.

Mesosoma. Sub-rectangular in lateral view; pronotum anteriorly rounded in dorsal view, a little wider than long and strongly sloping anteriorly in lateral view, its posterior part horizontal; promesonotal suture underlined by a weak furrow, forming an arch, widely concave posteriorly; promesonotal suture well marked in dorsal view; mesonotum almost flat dorsally; metanotal groove distinct but weak; sides of the propodeum weakly concave medially in dorsal view; metapleural gland orifice in profile as a short oblique slit, bounded below by a convex rim of cuticle that directs the orifice posterodorsally; the swollen bulla of the gland is visible through the integument, its anterior margin in touch with the propodeal spiracle; dorsal face of the propodeum weakly inclined and almost flat, gradually rounding beyond the spiracle towards the sloping posterior face; propodeal spiracle opened laterally and slightly downward, its large orifice bordered by a thin cuticular ring, its diameter (0.041 mm); propodeal lobes lacking.

Metasoma. Petiole short, higher than wide, shortly pedunculate and broadly constricted between abdominal pre- and postsegment; petiolar node broad, anterior face slightly concave in lateral view, the anterior apex sharp followed by a evenly curved posterior face; in dorsal face node trapezoidal, wider than long, posterior face strongly concave; spiracles on lateral protuberances near anterolateral base of node, their orifices circular, opening laterally and slightly posteriorly; sternite with a short medial carina lengthened anteriorly by a medium sized; subpetiolar process elongated triangular with a sharp point directed forward; gaster elongated, its maximal width at the level of abdominal segment IV; abdominal tergite III with a median short anterior carena strongly produced and seen in lateral view.

Sculpture. Cephalic capsule wholly sculptured with rugosities and punctuations; frons and vertex medially impressed by a narrow longitudinal band striae, from frontal lobes diffusely diverging just before the vertexal margin; the lateral margins of genae with weakly sinuous striae, almost all the dorsum of capsule is covered by scattered piliferous punctuations nearly aligned except on genae at the level of the antennal sockets, on the medial part of the frons and the vertex; punctuations denser dorsally than ventrally, conspicuously more impressed on the posterior two third of the capsule and especially dense at the transition between vertex and genae; mandibles smooth and shiny; pronotum and mesonotum with a dense piliferous punctuation except on a narrow median band and on anterolateral margins of the pronotum which are smooth and shiny; pronotum with narrow longitudinal smooth band; propodeum with a broad smooth and shining area widening toward the propodeal declivity; mesopleura with central area smooth and shining, nearly circular; propodeum finely striated and punctuated laterally but medially smooth and shining; petiole node dull with fine punctuations denser anteriorly and laterally, in lateral view mostly smooth and shining; gaster and femora entirely covered by sparse piliferous punctuation, weaker than on head and thorax.

Pilosity and color. Short and abundant on head and body. Erect hairs (longer than antennal segment 11) on clypeal dome, petiolar dorsum and gaster. Shorter erect hairs on most metasomal sterna; appressed pubescence formed by dense short setae, distributed on most of the body. Color: body reddish brown, antennae, and legs lighter.

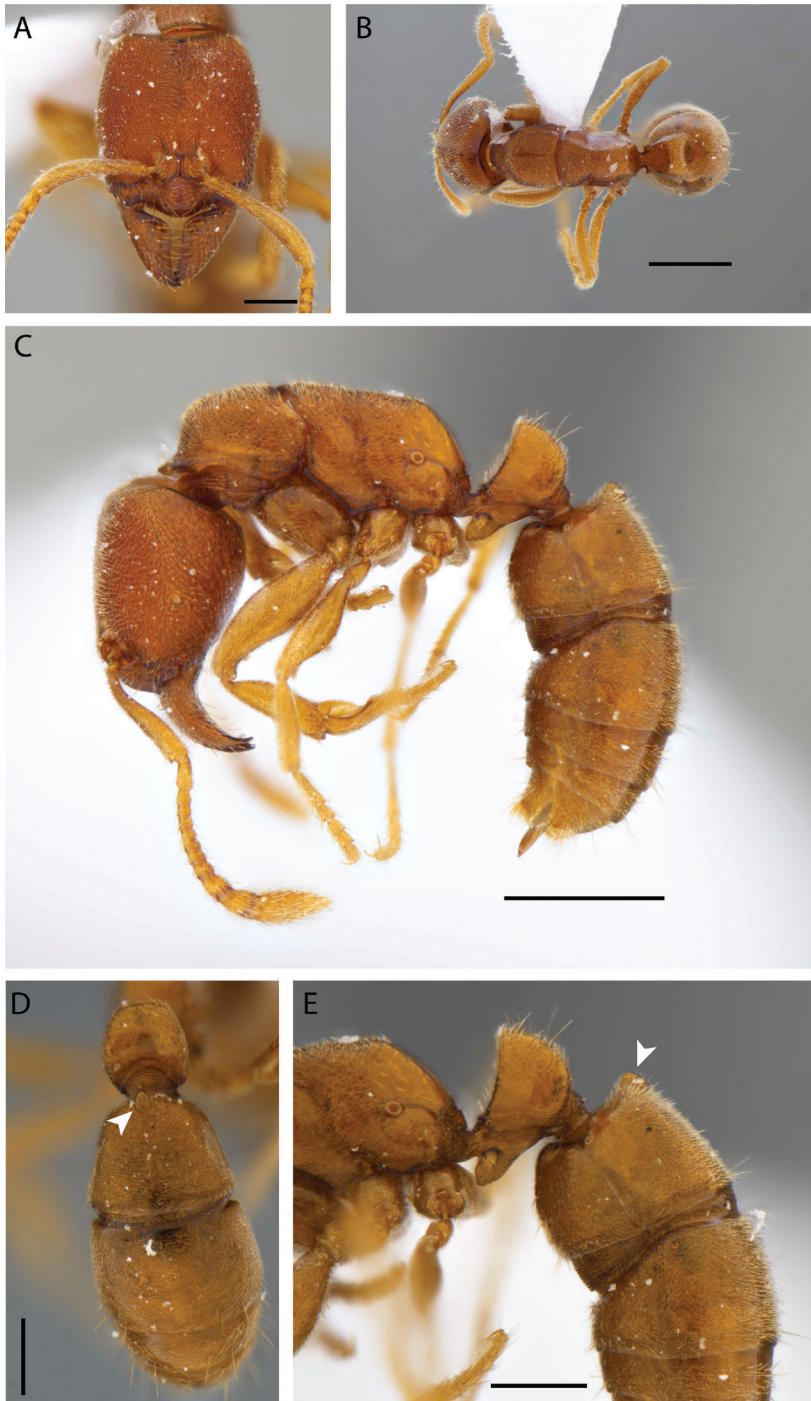


Figure 3. Photomicrographs of *Typhlomyrmex prolatius* (CATAC-00879) **A** head in frontal view **B** body in dorsal view **C** body in lateral view **D** postpetiolar carinae in dorsal view and **E** lateral view. Arrows pointing out the petiolar carinae. Scale bars: 0.25 mm (**A, D, E**); 0.5 mm (**B, C**).

Measurements. HW 0.578, HL 0.528, SL 0.464, PrW 0.307, PeW 0.239, PeL 0.314, PeH 0.305, WL 0.913, CI 109, SI 80, TL 1.85.

Diagnosis and comments. This species is easily separated from any other *Typhlomyrmex* by the possession of the short protruding carina on the anterior dorsum of the first metasomal tergum. This trait is described in the female of the species in Brown (1965) where they posit that it may be present in the worker. All workers examined in this work share this characteristic, so the possibility that it is a pointing error or a mutation in the first specimen observed by Brown is clearly ruled out. The function of this structure, if it exists, is unknown. As far as we know, this structure is unknown in other ants within this genus.

Distribution. Until this present work, the only confirmed localities of this species were in Central America (Brown 1965; Mackay et al. 2004; Dáttilo et al. 2020); however, records for Brazil and Venezuela were mentioned by Lacau et al. (2008) without pointing out the records; our records and the literature records establish an altitudinal distribution from 50 m to 1,200. m for *T. prolatus*. With these records, along with our own presented herein, we confirm the presence of this species in South America. Confirmed records range from Mexico to Colombia, with the possibility of having a broader distribution (see discussion).

Biological notes. *Typhlomyrmex prolatus* specimens examined in this study were collected exclusively in the soil at 0–10 cm depth; the collection substrate in previous records is unknown. This species has been found in fragmented rain forests in piedmont area. The individuals of CATAC-00879 were collected sharing the soil galleries with a colony of *Anoplotermes meridianus*.

Key to known *Typhlomyrmex* based on worker caste (modified from Lacau et al. 2004 and Camacho et al. 2020)

Worker of *T. foreli* unknown.

- 1 At least head frons with longitudinal striation or costulation..... 2
- Head never with conspicuous costulation, striation, if present, faint and limited to lateral sides 5
- 2(1) In dorsal view, mesosomal dorsum totally sculptured, usually costulate or rugulose 3
- In dorsal view, mesosomal dorsum with large smooth and shiny areas..... 4
- 3(2) In frontal view, scape not reaching the vertex margin; metacoxal dorsum with a lobe or denticle; in dorsal view, segments I and II of gaster (abdominal segments III and IV) covered by small ridges or striae, extending from the base of the hairs. Brazil *T. lavra* (Lattke)
- In frontal view, scape slightly surpassing the vertex margin; metacoxal dorsum unarmed; in dorsal view, segments I and II of gaster (abdominal segments III and IV) completely smooth and shiny. Brazil *T. lenis* (Camacho et al.)

- 4(2) Pronotum densely punctate, mesosoma lacking any striations; color generally yellow to light brown. Brazil *T. meire* **Lacau et al.**
- Pronotum densely costulate and striate, mesosoma with deep striations; color generally dark brown. Colombia and Venezuela *T. reichenspergeri* (**Santschi**)
- 5(1) Antennae 10 segmented, postpetiole (first metasomal tergum) with a distinct, sharp median carinae on the anterior third of its dorsal surface *T. prolatus* **Brown**
- Antennae with more than 10 segments, postpetiole without dorsal median tubercle or carena **6**
- 6(5) Anterior face of mesotibia with about 10 denticuliform erect setae (Fig. 4B); mandible shape elongated-subtriangular, their basal margins weakly convex, not reaching the anterior clypeal margin at full closure. Bolivia, Brazil, Colombia, Guiana *T. clavicornis* **Emery**
- Anterior face of mesotibia without denticuliform setae (Fig. 4A, C); mandible shape triangular, their basal margins rectilinear or weakly concave, fitting tightly against clypeus at full closure **7**
- 7(6) Petiole well pedunculate in lateral view; node poorly developed, longer than high, subconvex at its top and without a distinct posterior face; abdominal tergite III without obvious anterior face; size polymorphism marked. Neotropics *T. rogenhoferi* **Mayr**
- Petiole weakly pedunculate in lateral view; node well developed, higher than long, well rounded at its top and with a distinct posterior face; abdominal tergite III with a distinct anterior face; monomorphic **8**
- 8(7) Metafemora base (posterior view) sharply swollen ventrally, so that it forms a short vertical face at the base, joining the ventral face by an obtuse and rounded angle; head width >0.55 mm *T. major* **Santschi**
- Metafemora base (posterior view) poorly swollen ventrally, so that it does not form an angle at its base; head width <0.55 mm **9**
- 9(8) Clypeal lamella bearing a short and narrow median process, protruding, and clearly truncated at the apex (Fig. 5A). Colombia *T. encanto* **sp. nov.**
- Clypeal lamella not bearing a short and narrow median process (Fig. 5B, C). Widespread *T. pusillus* **Emery**



Figure 4. Photomicrographs comparing the mesofemur and mesotibia of **A** *T. encanto* sp. nov. **B** *T. clavicornis* **C** *T. prolatus*. Arrow pointing out the highly modified spiniform setae found only in the mesotibia of *T. clavicornis*. Scale bars: 0.2 mm (**A**, **C**); 0.1 mm (**B**).

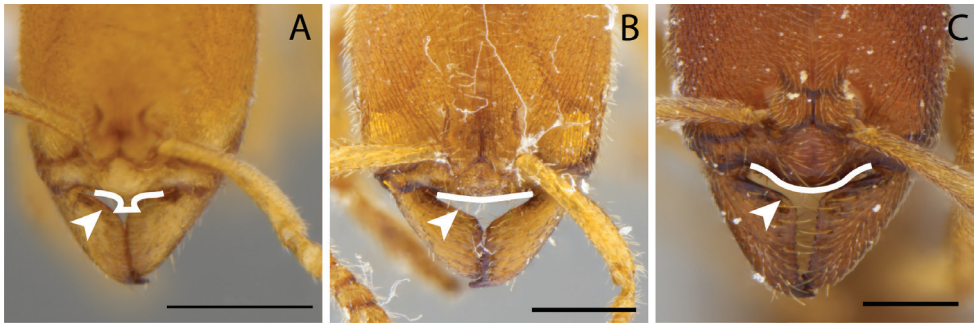


Figure 5. Photomicrographs comparing the clypeus of **A** *T. encanto* sp. nov. **B** *T. clavicornis* **C** *T. prolatus*. Arrow pointing out the highly modified clypeal projection found only in *T. encanto* sp. nov. Scale bars: 0.2 mm.

Discussion

Soil and subterranean ants tend to be under-studied and under-sampled, and thus less represented in biological inventories compared to other ants (Wong and Guénard 2021). *Typhlomyrmex* is a cryptic genus both in its taxonomy and its ecology (Lacau et al. 2008); Its current state seems to compare with that of other subterranean ant genera such as *Leptanilloides* Mann, which has many species still waiting to be described and a largely unknown ecology (Delsinne et al. 2015).

Most of the records reported in this work were collected in soil macrofauna sampling protocols, using the Tropical Soil Biology and Fertility (TSBF) monolith method (Anderson and Ingram 1993, ISO 2011). With the TSBF monolith method, *T. clavicornis* and *T. prolatus* were found even at a depth of 30 cm. Additionally, other species of *Typhlomyrmex* are also abundant at these depths, including *T. pusillus* (Castro et al. 2018b, Castro et al. 2023). This method, which focuses on soil fauna, seems to be useful for collecting cryptic organisms that are usually under-sampled with other methods such as *Winkler* sacs and *Berlese* traps (Castro et al. 2018a).

Based on our results, it can be inferred that *Typhlomyrmex* is a genus affected by the Wallacean shortfall (Bini et al. 2006; Meurgey and Ramage 2020). This premise had already been addressed by Lacau et al. (2004, 2008), where they state that *Typhlomyrmex* species, such as *T. pusillus* and *T. rogenhoferi*, are the most recorded species in the literature, likely due to their wide distribution that ranges from the southern South America to southern North America (Longino et al. 2002; Fernández and Sandoya 2004; Vittar 2008; Basset et al. 2012; Dáttilo et al. 2020; Camacho et al. 2022). Meanwhile, the greater diversity within this genus is largely unknown. Therefore, the presence of *T. prolatus* in South America further indicates that the information for the other *Typhlomyrmex* species is still very limited, and although the species richness may be higher than currently known, so too is the distribution of less abundant or taxonomically more cryptic *Typhlomyrmex* species. Another case of the Wallace shortfall in *Typhlomyrmex* is observed in *T. clavicornis* (Fig. 6B), although this species has records in five South American countries, including Brazil but only in the state of Rio de

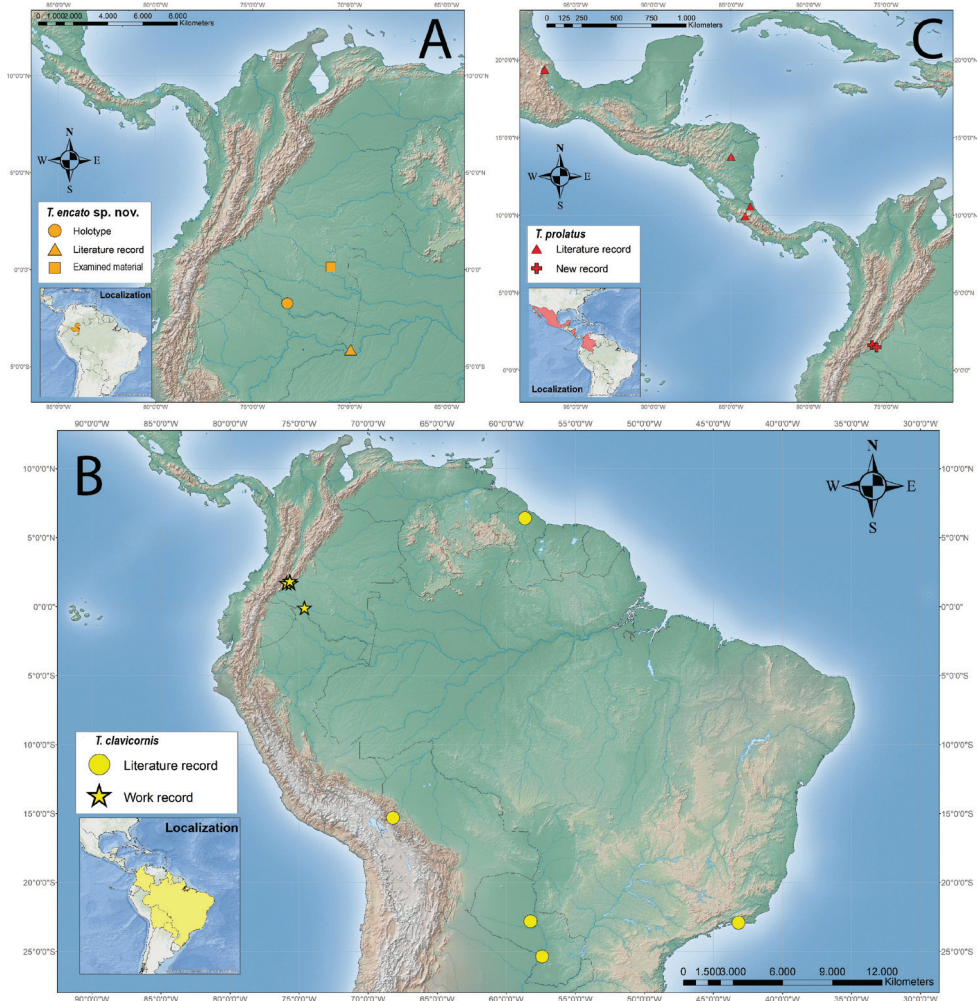


Figure 6. Distribution maps **A** *Typhlomyrmex encanto* sp. nov. **B** *Typhlomyrmex clavicornis* **C** *Typhlomyrmex prolatus*. Note: Literature record refers to records in the literature with coordinates available, records in literature without coordinates are not indicated in maps, but are mentioned in the distribution section of each species.

Janeiro in the southeast. The lack of records in the Brazilian Amazon basin and Cerrado, where it would be presumed to be present by the other valid records in countries with those biomes present; this study is intended to facilitate the identification of these widely distributed species and would help to reduce this biogeographical gap.

Although we described *Typhlomyrmex encanto* sp. nov., this species may have been reported in the literature as *Typhlomyrmex* sp. A (Lacau et al. 2008), however those specimens were not available for study. Given the difficulty in accessibility to the specimens described by Lacau et al. (2008), here we describe specimens from recent collections from

Colombia. In their treatment of the *Typhlomyrmex* from Colombia, Lacau et al. (2008) mention another unnamed species, *Typhlomyrmex* sp. B, which could potentially also be a new species. In the key provided by Lacau et al. (2008), they characterized *T.* sp. B with the following, translated from French: “Head capsule whose maximum width is located at two-thirds of its length, with weakly converging side faces anteriorly; occipital carina visible laterally; clypeus in dorsal view forming a wide, very flared convexity; clypeal lamella bearing a large well-advanced, convex median lobe but clearly truncated at the apex; scape in dorsal view, greatly enlarged towards the back in its distal half; wide and superficial metanotal furrow, little marked but distinct”. The authors refer to 6 workers with vouchers (SL#184, SL#185, SL#186, SL#529, SL#531 and SL#568) and labeled COLOMBIA, Caquetá PNN, Los Picachos, 1775m, 02°48'N, 74°40'W, Manual 3, 3. xi. 1997, F. Escobar, leg. in the IAvH collection. However, in a recent visit to the IAvH collection it was impossible to locate these workers with these voucher specimens, or any other material that could be associated with *Typhlomyrmex* sp. B. As is the case of *Typhlomyrmex* sp. A, the *Typhlomyrmex* sp. B description has not been published nor are there any plans to do so (Jacques Delabie, pers. comm.). Taxonomic work on cryptic groups such as this one is necessary to increase the knowledge of ant groups that, although currently under-studied and poorly understood, may be abundant and widely distributed.

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Supplementary material I

Measurements taken from pin mounted specimens

Authors: Fernando Fernández, Gianpiero Fiorentino, Daniel Castro

Data type: figure (.docx file)

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