Zootaxa 4208 (5): 446–458
http://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://doi.org/10.11646/zootaxa.4208.5.3
http://zoobank.org/urn:lsid:zoobank.org:pub:69728BA3-6562-43A0-9A8F-6DCF61817BD1

The ant genus *Linepithema* (Formicidae: Dolichoderinae) in Colombia

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Abstract

The species of *Linepithema* Mayr in Colombia are reviewed from collection material. The genus *Linepithema* comprises 20 species, of which the following are reported in Colombia: *L. angulatum* (Emery), *L. dispertitum* (Forel), *L. gallardoi* (Brèthes), *L. humile* (Mayr), *L. iniquum* (Mayr), *L. neotropicum* Wild, *L. piliferum* (Mayr), *L. tsachila* Wild, and a new species, *Linepithema hirsutum* **sp. nov.** *Linepithema dispertitum* is a new record for Colombia and South America. A taxonomic key (English and Spanish) and distribution maps to the species of *Linepithema* in Colombia are provided.

Key words: geographical distribution, Neotropical region, new record, new species, taxonomic keys

Resumen

Se revisaron las especies de *Linepithema* Mayr en Colombia a partir de material de colecciones. El género *Linepithema* comprende 20 especies, de las cuales en Colombia se reportan las siguientes: *L. angulatum* (Emery), *L. dispertitum* (Forel), *L. gallardoi* (Brèthes), *L. humile* (Mayr), *L. iniquum* (Mayr), *L. neotropicum* Wild, *L. piliferum* (Mayr), *L. tsachila* Wild, además de una nueva especie, *Linepithema hirsutum* **sp. nov.** *Linepithema dispertitum* es registrada por primera vez en Colombia y Suramérica**.** Se provee una clave taxonómica tanto en inglés como en español y mapas de distribución para las especies de *Linepithema* en Colombia.

Palabras clave: Claves taxonómicas, Distribución geográfica, Especie nueva, Nuevo registro, Región Neotropical

Introduction

The genus *Linepithema* Mayr is a Neotropical group of ants in the subfamily Dolichoderinae, whose closest relative is a predominantly Australian clade, rather than other Neotropical ants (Ward *et al.* 2010). These ants are small, with monomorphic workers, weakly sclerotized integument, and no spines or tubercles. The genus is distinguished by the following morphological characters of the workers: mandibles with a large apical tooth followed by a smaller preapical tooth and a series of 3–4 small teeth alternating with denticles, and a slightly concave anteromedial clypeal margin (Wild 2007). Males differ from other Neotropical dolichoderines by the finely serrate mandible with a smooth basal margin, axillae that broadly meet, and squamiform petiole (B.E. Boudinot, pers. comm.).

The monophyly of the genus has been corroborated with molecular data by Wild (2009) and Ward *et al.* (2010). Previously, Shattuck (1992) proposed two groups related to the species *L. fuscum* Mayr and *L. humile* based on male morphology. Later, Wild (2007) defined 19 species of *Linepithema*, arranged in four groups related to the species *L. fuscum*, *L. humile*, *L. iniquum* and *L. neotropicum* (The species *L. aztecoides* Wild and *L. pulex* Wild have unclear positions). The monophyly of these four groups was later supported by molecular data (Wild 2009).

 Accepted by J. Longino: 3 Nov. 2016; published: 20 Dec. 2016

In Colombia, Wild (2007) recorded species from the *L. fuscum*-group (*Linepithema angulatum*, *Linepithema piliferum*, and *L. tsachila*), the *L. humile*-group (*Linepithema gallardoi* and *L. humile*), the *L. iniquum*-group (*L. iniquum*), and the *L. neotropicum*-group (*L. neotropicum*) for a total of seven species. Regarding the known distribution of *Linepithema* in Colombia, the richness of species is greater in the Andean region, but some species, including *L. gallardoi* and *L. neotropicum*, are found in the Caribbean and Pacific regions. Other species are recorded in neighboring countries, *e.g.*, *L. dispertitum* in Panama, and *L. fuscum* Mayr in Peru, and are potentially present in Colombia (Wild 2007). In local researches, *Linepithema* has been recorded in the departments of Cauca (Mera *et al*. 2010; Ramírez *et al*. 2010), Nariño (Bustos 1994) and Valle del Cauca (Bustos & Ulloa-Chacón 1996; Chacón de Ulloa *et al*. 2006; Ramírez *et al*. 2010; Sanabria & Chacón de Ulloa 2009).

Some species of *Linepithema* (e.g., *L. humile*, *L. micans* [Forel]) are of importance because they are invasive and have negative impacts on native fauna (Lach 2008). The misidentification of these species may lead to poor administrative decisions and investment of economic resources (Bortolus 2008; Casciotta *et al*. 2013). *Linepithema humile* can be a serious invasive pest ant, and it has been reported from Colombia (Sanabria & Chacón de Ulloa 2009; Wild 2004, 2007). It is particularly important to confirm these identifications and assess the status of the species in Colombia.

In this paper, we report the species of *Linepithema* occurring in Colombia using specimens from local collections and literature records, and we provide geographical distribution by department of the examined material. We provide a worker-based taxonomic key to the species in Colombia, and describe a new species, *L. hirsutum* **sp. nov.**

Material and methods

We examined specimens deposited in the following entomological collections:

CBUMAG Centro de Colecciones Biológicas de la Universidad del Magdalena, Santa Marta, Magdalena, Colombia.
IAvH Instituto de investigaciones en recursos biológicos Alexander von Humboldt, Villa de Leyva, Boyacá, Colombia.
ICN-MHN Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogot D.C., Colombia.
MUSENUV Museo de Entomología de la Universidad del Valle, Valle del Cauca, Santiago de Cali, Colombia.
WPMC William P. MacKay personal collection, El Paso, Texas, USA.

We used the worker-based key to species of *Linepithema* in Wild (2007). Males and queens were not examined in this work because of lack of material in the visited collections. We also compared the examined material with high resolution images downloaded from www.antweb.org.

Specimens were observed using a Nikon SMZ 745 stereomicroscope in the entomology laboratory of Universidad del Magdalena, the entomological collection of the IAvH, and ICN-MHN. Measurements were made using a micrometric ruler with a precision of 0.01 mm, calibrated for the stereomicroscope at 80 x magnification.

The morphometric characters employed and their definition are the same used by Wild (2007). The head characters were measured with the head in full-face view.

The measurements used (in mm) are: head length (**HL**), head width (**HW**), antennal scape length (**SL**), eye width (**EW**), eye length (**EL**), minimal frontal carinal width (**MFC**), profemur length (**FL**), metatibial length (**LHT**) and pronotal width (**PW**). Some relations between characters were calculated (Wild 2007): eye size (**ES**) = 100***EL*****EW**; scape index (**SI**) = 100***SL**/**HL**; cephalic index (**CI**) = 100***HW**/**HL**; carinal distance index (**CDI**) = 100***MFC**/**HW**; ocular index (**OI**) = 10***ES**/**HL**. We also studied in detail the pubescence and pilosity of the body, propodeum shape, mesonotum shape, head shape, and body color.

Color montage images of the species were created using an Auto-Montage Leica M205A and the images were combined using the program LAS v. 4.6. Ant figures were arranged using Adobe Photoshop cs5.

Distribution maps for each species of *Linepithema* in Colombia were made with DIVA-GIS (Hijmans *et al*. 2004b), using information from specimen collection labels: Country, Department, Minor administrative units (m.a.u), latitude, longitude, and altitude (meters above sea level). When the label did not have the complete information, geographic coordinates were obtained with the directory www.fallingrain.com/world/CO/.

Results

We identified eight species of the genus *Linepithema* in Colombia. These include six of the seven species reported by Wild (2007). We exclude *L. humile* from the known fauna, concluding that previous records were misidentifications. We report *L. dispertitum* for the first time, and we describe a new species, *L. hirsutum*.

Key to the species of *Linepithema* in Colombia based on workers

1. Anterior portion of the metapleural gland orifice with moderate to abundant appressed hairs (sometimes individuals must be observed in dorsal-oblique position) 2
- Anterior portion of the metapleural gland orifice lacking pubescence, or with a few scattered appressed hairs 4
2. Pronotum with one pair of erect setae (may be lost); maxillary palps long, more than half of HL; metanotal groove slightly or not impressed; propodeum low and rounded . . . . . *L. neotropicum*
- Pronotum usually without erect setae, rarely with one pair; length of maxillary palps half or less than HL; metanotal groove slightly to moderately impressed; propodeum inclined anteriorly, with dorsal and posterior face forming an obtuse angle. . . . 3
3. Antennal scapes relatively short, usually less than HL; pronotum and first gastric tergite bearing setae (sometimes may be lost); mesonotum angular, with a posterior declivous face and sometimes swollen. . . . . *L. gallardoi*
- Antennal scapes long, equal or longer than HL; pronotum and first gastric tergite without setae; mesonotum straight, not angular or swollen. . . . . *L. humile*
4. Posterior portion of clypeus with a weakly developed to absent groove (presutural clypeal groove) 5
- Presutural clypeal groove well-developed 6
5. Dorsum of the head with more than 5 erect setae, mesosoma slender, dorsum of the mesonotum with a moderate to strong medial impression, body surface glossy and shiny . . . . . *L. iniquum*
- Dorsum of the head never with more than 5 erect setae, mesosoma more robust, medial impression on the mesonotum slightly impressed or not impressed at all, body not as glossy and shiny . . . . . *L. dispertitum*
6. Pronotum bearing more than 10 erect setae, whole body surface with long or short erect setae . . . . . *L. hirsutum*
- Pronotum with fewer than 10 erect setae, whole body surface never covered with erect setae 7
7. Posterior margin of the head deeply concave, dorsum of mesonotum never with a medial impression, pronotum usually with 4 (2–8) erect to suberect setae . . . . . *L. tsachila*
- Posterior margin of the head straight to slightly concave, dorsum of mesonotum without medial impression or slightly impressed, pronotum never with more than 4 erect setae 8
8. Antennal scapes short, surpassing the posterior margin of the head by less than length of the pedicel; propodeum relatively high, with distinct anterior, dorsal and posterior faces, sometimes dorsal face slightly depressed . . . . . *L. angulatum*
- Antennal scapes relatively long, surpassing the posterior margin of the head by at least length of the pedicel; propodeum usually rounded, not as above. . . . . *L. piliferum*

Clave taxonómica para las especies del género *Linepithema* en Colombia

1. Porción anterior a la bula de la glándula metapleural con pelos adpresos en cantidad moderada a abundante (A veces los individuos deben ser observados en posición dorso-oblicua) 2
- Porción anterior a la bula de la glándula metapleural con unos pocos o careciendo de pelos adpresos. 4
2. Pronoto con un par de setas erectas (pueden estar caídas), palpos maxilares largos, más de la mitad de la longitud de la cabeza; surco metanotal ligeramente marcado o no marcado, propodeo bajo y redondeado . . . . . *L. neotropicum*
- Pronoto usualmente sin setas erectas, raras veces un par; palpos maxilares con una longitud máxima igual o inferior a la longitud de la cabeza; surco metanotal marcado ligeramente o de manera moderada; propodeo inclinado hacia adelante, con una cara dorsal y una posterior formando un ángulo obtuso 3
3. Escapos antenales relativamente cortos, usualmente con un tamaño inferior a la longitud de la cabeza; pronoto y primer terguito del gáster con setas (a veces pueden estar perdidas); mesonoto angular, con un declive posterior y en ocasiones abultado . . . . . *L. gallardoi*
- Escapos antenales largos, iguales o mayores a la longitud de la cabeza; pronoto y primer terguito del gáster sin setas; mesonoto recto, no angular o abultado . . . . . *L. humile*
4. Porción posterior del clípeo con un surco débil o sin surco (surco pre-sutural del clípeo) 5
- Surco pre-sutural del clípeo presente y bien marcado. 6
5. Dorso de la cabeza con más de 5 setas erectas, mesosoma esbelto, dorso del mesonoto con una impresión media moderada a fuerte, superficie del cuerpo brillante y lustrosa . . . . . *L. iniquum*
- Dorso de la cabeza nunca con más de 5 setas, mesosoma más robusto, mesonoto con una impresión media ligeramente impresa o ausente, cuerpo no tan brillante y lustroso como arriba. . . . . *L. dispertitum*
6. Pronoto con más de 10 setas erectas, superficie de todo el cuerpo con setas erectas largas o cortas . . . . . *L. hirsutum*
- Pronoto con menos de 10 setas erectas, superficie de todo el cuerpo nunca cubierto con muchas setas erectas 7

7. Margen posterior de la cabeza profundamente cóncavo, dorso del mesonoto nunca con una impresión medio, pronoto usualmente con 4 (2–8) setas erectas a suberectas . . . . . *L. tsachila*
- Margen posterior de la cabeza recto a ligeramente cóncavo, dorso del mesonoto con una ligera impresión media o sin impresión, pronoto nunca con más de 4 setas erectas 8
8. Escapos antenales cortos, sobrepasando el margen posterior de la cabeza por una longitud inferior a la del pedicelo, propodeo relativamente alto, con caras anterior dorsal y posterior distinguibles, a veces la cara dorsal ligeramente deprimida . . . . . *L. angulatum*
- Escapos antenales relativamente largos, sobrepasando el margen posterior de la cabeza por una longitud igual o superior a la del pedicelo, propodeo usualmente redondeado, no como arriba . . . . . *L. piliferum*

Species accounts

Linepithema angulatum

Distribution. *Linepithema angulatum* is mainly distributed in high altitude localities, with most of the records over 1000 m (ranging from 10 to 2430 m). This species was previously recorded in the departments of Antioquia, Boyacá, Cauca, Caquetá, Cundinamarca, Huila, Meta, Putumayo, and Valle del Cauca (Wild 2007; Mera *et al*. 2010; Ramirez *et al*. 2010; Calle *et al*. 2013; Simbaqueba-Cortés *et al*. 2015). We expand the distribution records in Colombia to the departments of Caldas, Magdalena, Nariño, Quindío, Risaralda, Santander, Tolima and Vichada, with most of the records from the central region, in the Andean mountain system (Fig. 3).

Biology. *Linepithema angulatum* is considered a generalist ant (Calle *et al*. 2013) that usually inhabits anthropogenic modified ecosystems. It was collected in pine, bean, coffee, and peach crops, mature forest fragments, and home gardens. Interactions with other organisms are recorded from specimens labels, for example, attending aphids, and membracids; commensalism interactions with other insect families such as Curculionidae, Cercopidae, Forficulidae and Dryinidae have been also reported (Mera *et al*. 2010). Some records showed *L. angulatum* nesting in *Cecropia* sp.; this plant, native to the Neotropics, is usually associated with ants of the genus *Azteca* Forel (Longino 1991).

Examined material: BOYACÁ: Sutamarchán, 2150 m (IAvH); Villa de Leyva, 2200 m (IAvH); Gachantivá, Hatillo Socha (IAvH); Gachantivá, Minas, (IAvH); Moniquirá, Vda. San Esteban, (IAvH); Moniquirá, Vda. Ubanza, (IAvH); Moniquirá, Vda. Jordán (IAvH); Moniquirá, Vda. Novillero, (IAvH). CALDAS: Aguadas, Cañón Río Arma, 1995 m, (IAvH); Aranzazu, Vda. Chambery, Fca. Maranduba, 2050 m, (IAvH); Aranzazu, Vda. Chambery, Fca. Las Garzas, 1980 m, (IAvH). HUILA: San Agustín, Vda. La Castellana, 2320–2430 m (IAvH). MAGDALENA: PNN Tayrona, Neguanje, 10 m (IAvH). NARIÑO: R.N La Planda, Vía Hondón, 1930 m, (IAvH). PUTUMAYO: PNN La Paya, Garzacocha, (IAvH); PNN La Paya, Mesón, 320 m, (IAvH). QUINDIO: Alcalá, Los Guayabos, 1054 m, (MUSENUV). RISARALDA: Pereira, Vda. La Suiza, SFF Otún Quimbaya, 1820 m, (IAvH); Pereira, Vda. La Suiza, SFF Otún Quimbaya, 1900 m, (IAvH); Pereira, Vda. Yarumal, Fca. El Cedral, 1840 m, (IAvH). SANTANDER: Vélez (IAvH); Vilorin, Costilla de Fara, 1800 m, (IAvH); Encino, RN Cachalu, 2000 m, (IAvH); Oiba, San Vicente, (IAvH); Vilorin, Cachalu, 2150–2200 m, (IAvH). TOLIMA: Fresno, (IAvH). VICHADA: Cumaribo, Cgto. Santa Rita, PNN El Tuparro, 135 m, (IAvH).

Linepithema dispertitum
(Figs. 2A–2F, 4)

Distribution. Ramirez *et al.* (2001) reported *L. dispertitum* from a tropical dry forest in the eastern region of Colombia between the Western and Central Cordilleras, however Wild (2007) found this species only in Central America and Hispaniola. Further identification of *Linepithema* specimens from MUSENUV, the museum where the specimens are deposited, corroborated the absence of this species in that Colombian region. We report *L. dispertitum* for the first time in Northern Colombia and South America, from ants collected in the departments of Cesar and La Guajira. The collection sites were three nearby localities in the Serranía del Perijá over 2790 m (ranging from 2790 to 2997 m) bordering with Venezuela (Fig. 4).

Biology. *Linepithema dispertitum* was found in high altitudes, in accordance with the reports in Wild (2007). Specimens were collected with pitfall traps and manually in a paramo landscape, where the annual precipitation is

1300–1400 mm, and the average temperature between 10–12°C (Hijmans *et al*. 2004a). Workers were walking on the soil and under rocks, where the species probably nests. This behavior contrasts with its sister species, *L. iniquum*, which is considered an arboreal ant.

Discussion. Wild (2007) mentions that *L. dispertitum* presents allopatric morphological variation, identifying four phenotypes along its distribution in Central and North America. We observed three different phenotypes occurring in different sites of the Serranía del Perijá. One is similar to populations from central México: yellow-brown (Figs. 2C, 2D), lacking erect setae on the cephalic dorsum, and pubescence fading to sparse on gastric tergites 3–4. A second variation is similar to populations from Chihuahua (Mexico): bicolored (Figs. 2A, 2B), with four erect setae on the cephalic dorsum, setae on the pronotum, and moderate pubescence on gastric tergites 3–4. The third variation is curiously similar to a single collection from Baja California: it is bigger (HW 0.75), dark and concolored (Figs. 2E, 2F), with 5 erect setae on the cephalic dorsum, and some sparse hairs on the mesopleura. In Colombia, populations with the same pattern of variability are sympatric, occurring relatively close each other in altitudes above 2500 m in the Serranía del Perijá (Fig. 4) and in some cases cohabiting the same environment (Department of Cesar).

Examined material. CESAR: Serranía del Perijá, Manaure, Sabana Rubia, 2850–2903 m; Serranía del Perijá, La Paz, San José de Oriente, 2493 m (CBUMAG). LA GUAJIRA: La Jagua del Pilar, Cerro Pintao, 2790 m (CBUMAG).

Linepithema gallardoi

Distribution. *Linepithema gallardoi* occurs mostly in the Central region of Colombia over 1000 m (1054 to 2600 m). It was previously recorded in the departments of Boyacá, Cundinamarca, Magdalena, Risaralda and Valle del Cauca (Wild 2007); herein we expand the geographical distribution to the departments of Caldas and Quindío (Fig. 4).

Biology. In Colombia, *L. gallardoi* occurs in high altitude localities. In the department of Caldas, the specimens were collected with pitfall traps near live fences. Workers from Boyacá were collected with Malaise trap, perhaps while foraging.

Examined material. BOYACÁ: SFF Iguaque, 2450 m (IAvH); SFF Iguaque, 2600 m (IAvH). CALDAS: Aranzazu, Vda. Chupaderos, Fca. Alegrias, 1960 m (IAvH); Aranzazu, Vda. Chupaderos, Fca. Alegrias, 1960 m (IAvH). QUINDÍO: Alcalá, Los Guayabos, 1054 m (MUSENUV).

Linepithema hirsutum sp. nov.

(Figs. 1A, 1B, 3)

Holotype worker. NARIÑO: Barbacoas, Reserva Natural El Pangán, 1º21'49"N 78º4'45"W, 640 m, manual collection, 28.vii.2006, A. Miranda and O. Reyes, deposited in IAvH (IAvH-E 95404).

Paratypes. Same data as holotype, deposited in CCBUMAG (1w, CBUMAG 06968), IAvH (35w), and the California Academy of Sciences (1w, CASENT0179544).

Holotype worker measurements. HL 0.70, HW 0.66, MFC 0.16, SL 0.64, FL 0.62, LHT 0.64, ES 1.4, PW 0.44, CI 94, SI 91, CDI 24, IO 20.

Worker measurements. (n= 31) HL 0.56–0.70, HW 0.40–0.68, MCF 0.12–0.16, SL 0.54–0.70, FL 0.50–0.62, LHT 0.46–0.70, ES 0.96–1.68, PW 0.36–0.48, CI 67–97, SI 91–107, CDI 21–36, IO 15–25.

Worker diagnosis. Many erect setae on body; pronotum with more than 10 erect setae; surface anterior to the metapleural gland orifice lacking pubescence; body color yellow.

Worker description. Head longer than wide (CI 67–97), lateral margins of head convex, posterior margin almost straight to slightly concave (Fig. 1A). In full-face view, head reaches widest point behind compound eyes level. Compound eye size small to moderate (OI 15–25), with 38–40 ommatidia. Antennal scape short to moderately long (SI 91–107), exceeding posterior margin of the head by almost 1/4 its scape length. Frontal carinae narrowly to broadly separated (CDI 21–36). Maxillary palps of moderate length, below ½ HL, segment 6 shorter to somewhat same length than segment 2. Pronotum and anterior portion of mesonotum form continuous

convexity. Mesonotal dorsum usually with slight medial impression. Metanotal groove moderately impressed. In lateral view, propodeum frequently high, with dorsal face rounded to straight (Fig. 1B). Petiolar scale sharp and anteriorly inclined. Head with numerous erect setae on the lateral and posterior margins; more than 10 erect setae on head dorsum, excluding those on clypeus. Pronotum with 12–24 erect setae, usually 2–4 setae are longer than rest of pronotal setae. Dorsum of the mesonotum and propodeum with 10–20 short erect setae. Petiolar scale with 4–8 erect setae. Gastral tergites with numerous erect setae shorter than those on the mesosoma. Legs and antennal scape with numerous short erect setae. Dorsal surface of head and mesosoma dull to moderately shining; sculpture on scapes shagreened or granular. Pubescence dense on head, mesosomal dorsum, anterior face of petiolar scale, and gastric tergites 1–4. Meso- and metapleura smooth and shiny, lacking pubescence.

Queen and Male: Unknown.

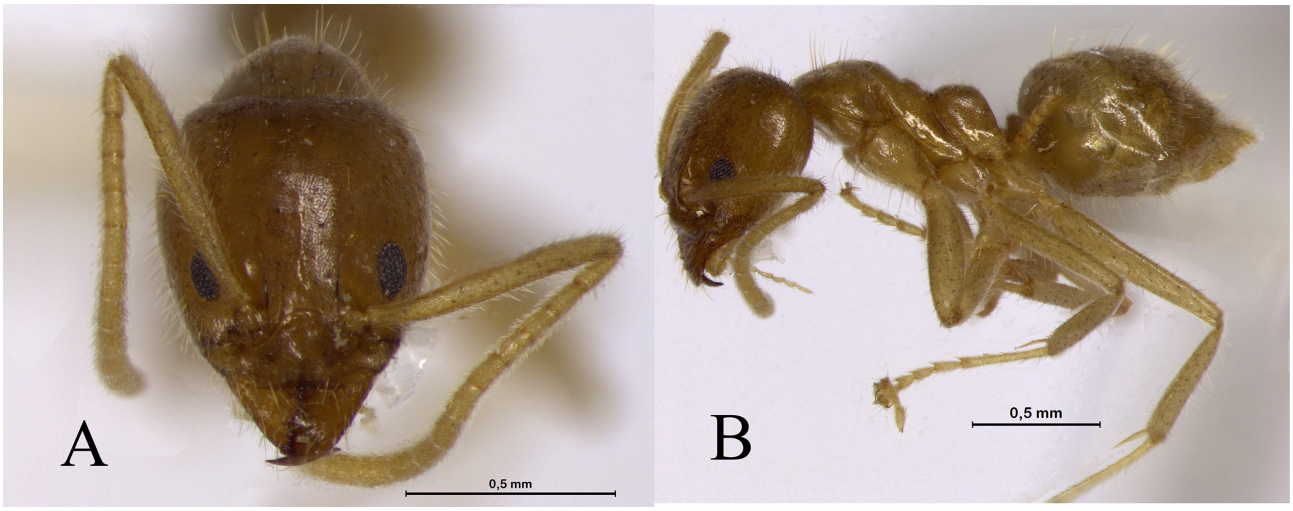

FIGURE 1. *Linepithema hirsutum* worker paratype (CBUMAG 06968).

Distribution. *Linepithema hirsutum* is known from a single location in Reserva Natural el Pangán, department of Nariño (Fig. 3).

Biology. The specimens of *L. hirsutum* were collected at 640–671 m with pitfall traps, Winkler traps, and hand collection in a tropical rainforest in the Reserva Natural El Pangán. The yearly temperature range of Pangán is between 12–24°C.

Etymology. From Latin *hirsutus* because of the many erect hairs on the body surface. This name is a neutral noun.

Discussion. *Linepithema hirsutum* is the only species of *Linepithema* with numerous erect setae throughout the body surface. *L. tsachila* has no more than eight erect setae on the pronotum, while *L. hirsutum* has 12–24. Variation in the number of erect setae was found; larger specimens had more and longer setae, and smaller specimens had shorter and fewer setae. We propose that this species is in the *L. fuscum*-group, on account of the lack of metapleural pubescence and the presence of a well-developed clypeal groove.

Examined material. NARIÑO: Barbacoas, Reserva Natural el Pangán, 1º21’49”N 78º4’45”W, 640m, Manual; 1º21'N 78º5'24"W, 671m, winkler and pitfall trap (IAvH).

Linepithema humile

Distribution. *Linepithema humile* is known only from Armenia (Quindio).

Biology. The biology of this important species is summarized by Wild (2007).

Examined material. COLOMBIA. Quindío: Armenia (WPMC).

Discussion. *Linepithema humile* was previously reported in Colombia (Sanabria & Chacón de Ulloa 2009; Wild 2004, 2007). However, we found that the specimens identified as *L. humile* in Sanabria & Chacón de Ulloa (2009), and many other “*Linepithema humile*” specimens in Colombian entomological collections, were misidentified. In most cases these specimens were *L. piliferum* or *L. neotropicum*, and in no cases were *L. humile.*

In order to confirm the occurrence of *L. humile* in Colombia (Wild 2007), we studied the *L. humile* specimens reported in Wild (2007) and deposited in WPMC. We confirm that the specimens are *L. humile*, and this remains the only known collection of the species in Colombia. These ants were collected in the Colombian coffee zone (Armenia, Quindio) in 1973, but despite subsequent intensive sampling done in that area by the program Paisajes Rurales (Instituto Alexander von Humboldt), there are no more *L. humile* records from Armenia or elsewhere. Thus it is possible that this was an introduction that did not persist and the species no longer occurs in Colombia.

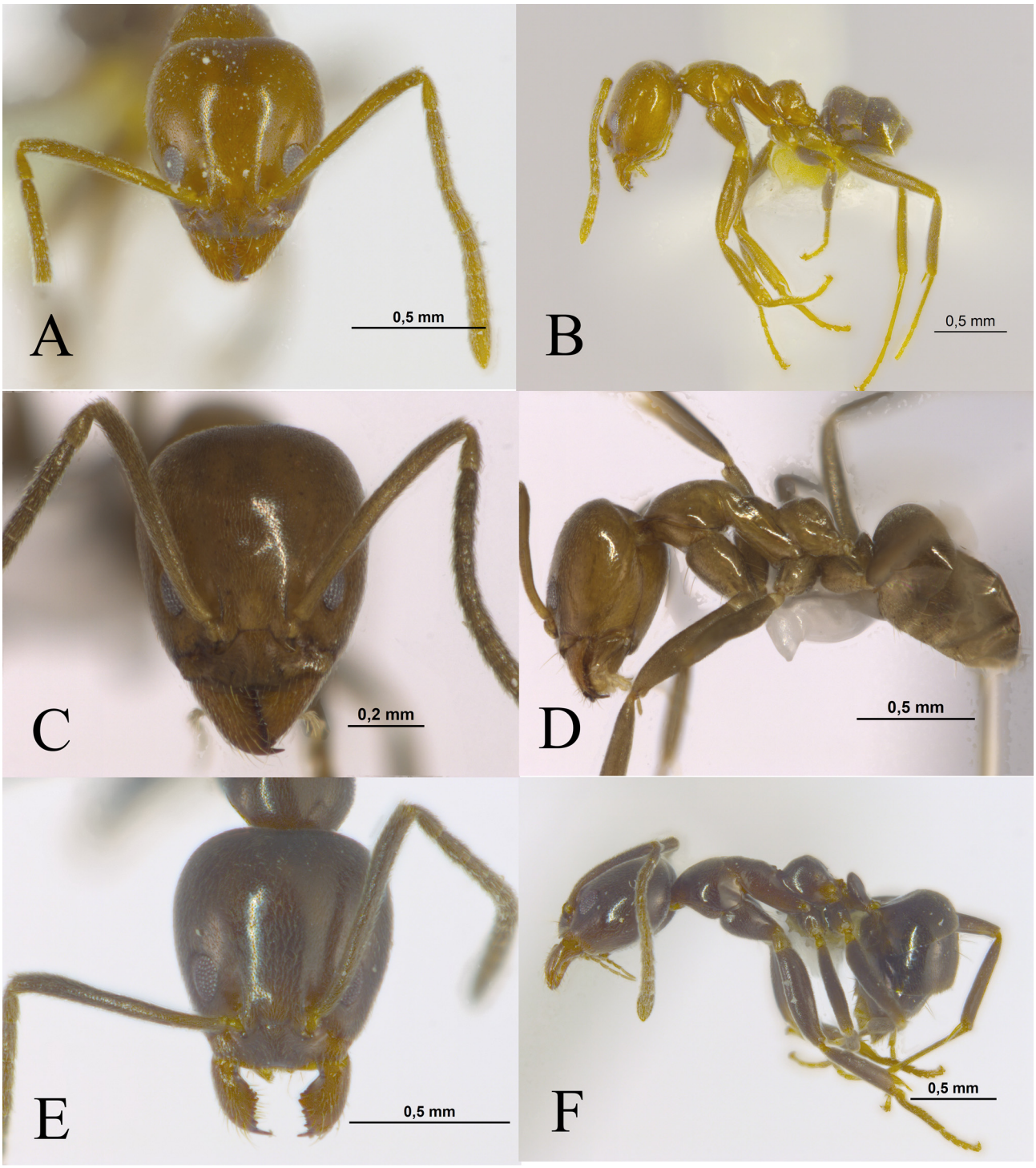

FIGURE 2. *Linepithema dispertitum* workers. A–B: Colombia, Cesar, CBUMAG-06576. C–D: Colombia, Guajira, CBUMAG-06577. E–F: Colombia, Cesar, CBUMAG-06575.

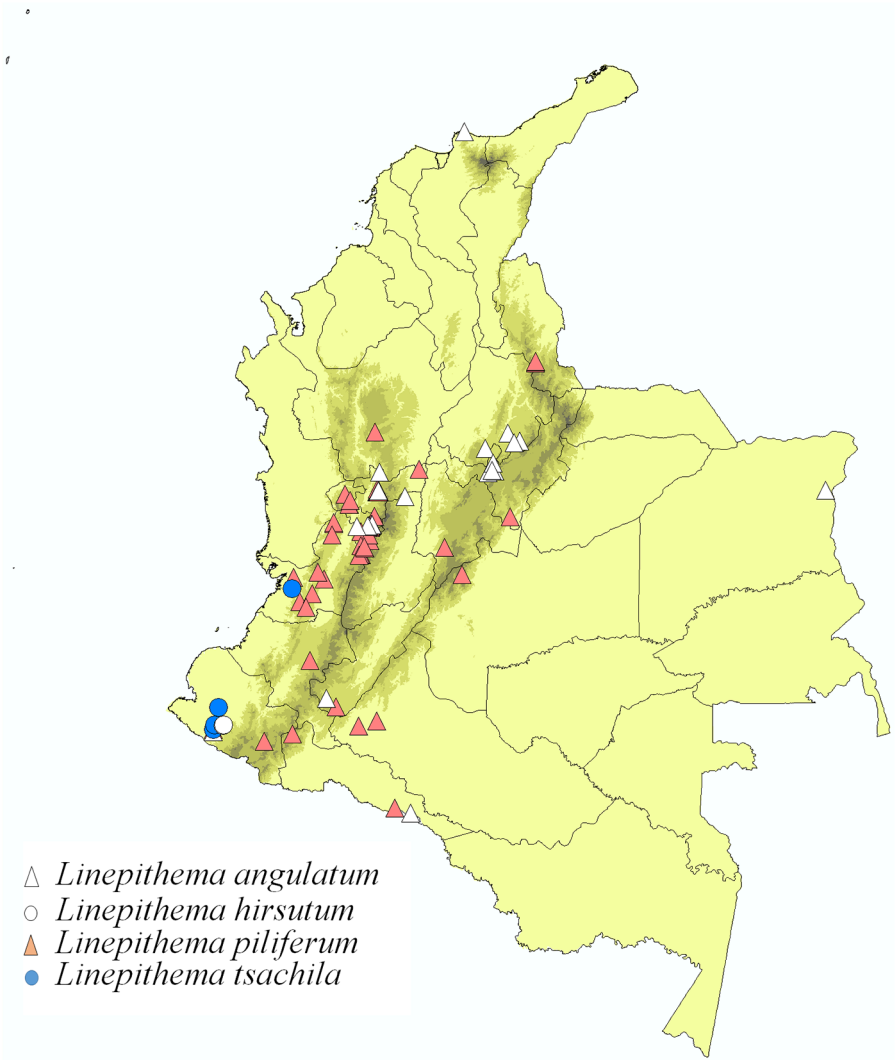

FIGURE 3. *Linepithema fuscum*-group distribution in Colombia from examined material.

Linepithema iniquum

Distribution. *Linepithema iniquum* was recorded over 940 m (940–1995 m) with most of the records from the central region of the country in the Andean mountain system and in the Sierra Nevada de Santa Marta. This species was previously reported in the departments of Antioquia, Cundinamarca, La Guajira, Quindío, Risaralda and Valle del Cauca (Wild 2007; Vergara-Navarro & Serna 2013). Here we expand the distribution records to the departments of Caldas and Magdalena (Fig. 4).

Biology. *Linepithema iniquum* is an arboreal ant that prefers high altitude places. In some localities, this species was collected in coffee crops and trees. In one collection from the Sierra Nevada de Santa Marta, sector San Pedro de la Sierra, this species was found nesting inside a stick on the leaf litter along with an unidentified *Pheidole*. In the stick, larvae and pupae of both species were found, in addition to *L. iniquum* males. In the laboratory, the *L. iniquum* workers seemed to feign death (thanatosis) when threatened. Food chambers were observed, containing the heads and bodies of insects such as bees (Halictidae) and flies (Diptera).

Examined material. CALDAS: Aranzazu, Vda. Buenavista, Fca. La Palma, 2025 m (IAvH); de Aranzazu, Vda. la Guaira, Fca. Alto Bonito, 2056 m (IAvH); de Aguadas, Cañon río Arma, 1995 m (IAvH); de Salamina, Vda. la Aurora, Fca. el Porvenir, 1805 m (IAvH). MAGDALENA: Sierra Nevada de Santa Marta, San Lorenzo, 1495 m (CCBUMAG); Sierra Nevada de Santa Marta, San Pedro de la Sierra, 1194 m (CCBUMAG). QUINDIO: Alcalá, Lusitania, 1215 m (MUSENUV); Calarcá, Vda. Pradera Baja, 1575 m (IAvH); Genova, Vda. el Cedral,

Fca. Venecia, 1800 m (IAvH); Pijao, Vda. la Playa, 1800 m (IAvH). RISARALDA: Apia, 1470 m (IAvH); La Virginia, 940 m (MUSENUV); Pueblo Rico, Santa Cecilia, 2430 m (ICN). VALLE DEL CAUCA: Cali, Bosque el Saladito, 1650 m (IAvH); El Cerrito, Fca. el Hatico, 980 m (MUSENUV).

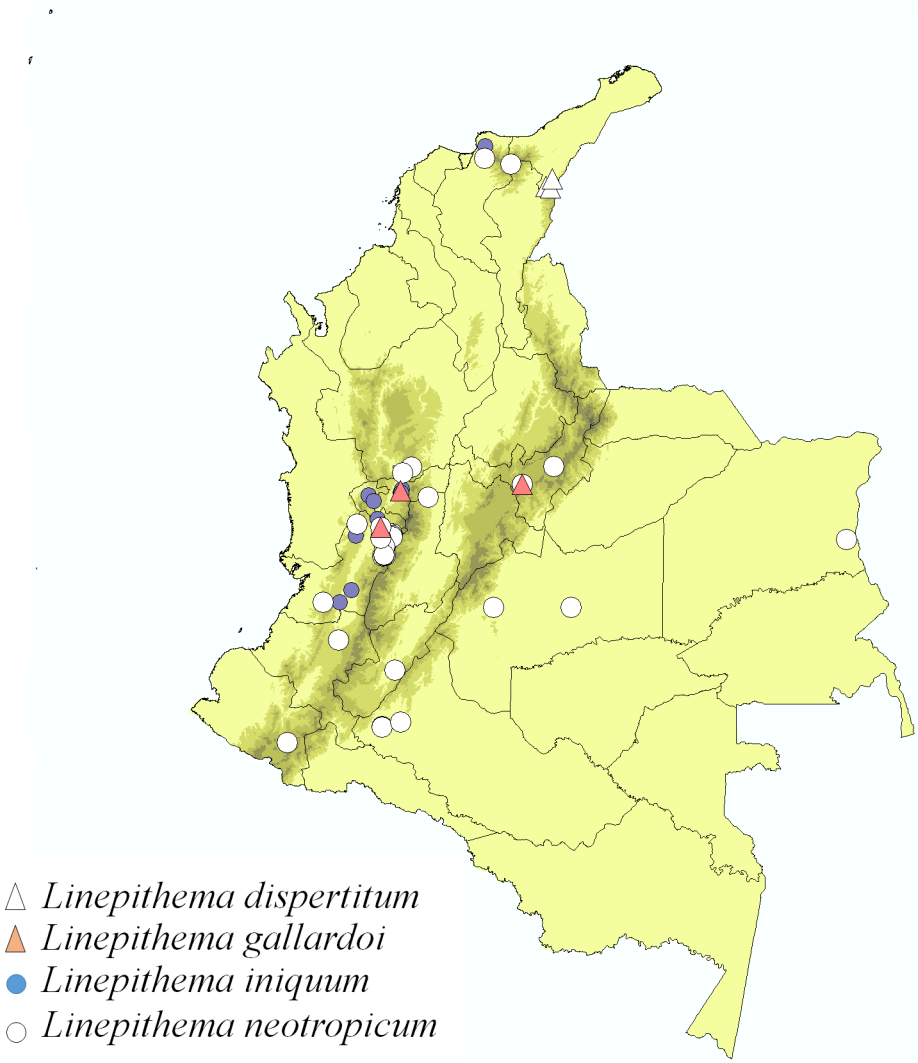

FIGURE 4. *Linepithema gallardoi*, *L. neotropicum* and *L. iniquum* distribution in Colombia from examined material.

Linepithema neotropicum

Distribution. *Linepithema neotropicum* is a species with a broad altitudinal distribution and varied habitat occupancy. It ranges from 260 to 2600 m altitude, with most of the records corresponding to high altitudes in the Central region of the country, but it was also found in plains to the East and near the Amazonas forest to the South. It was previously recorded in the departments of Huila, La Guajira, Meta, Tolima and Valle del Cauca (Mera *et al*. 2010; Ramirez *et al*. 2010); here we expand distributional records to the departments of Antioquia, Boyacá, Caldas, Caquetá, Cauca, Magdalena, Nariño, Quindío, and Vichada (Fig. 4).

Biology. *Linepithema neotropicum* was captured with different sampling methods (pitfall, entomological net, Malaise trap, Winkler trap, and beating tray) suggesting variable habits. Some specimen records are from paddocks. In other collections, this species was attracted to human excrement.

Examined material. ANTIOQUÍA: Sonsón, Quebrada la Violeta, 1000 m (IAvH); Medellín, Campus Unal, 1561m. BOYACÁ: Sogamoso, Vda. Moniquirá, Pie de Cuesta, 2455 m (SCB); SFF Iguaque, Cabaña Chaina, 2600

m (IAvH). CALDAS: Aguadas, Cañón Rio Arma, 1995 m (IAvH); Aguadas, La Playa, 1610 m (IAvH). CAQUETÁ: Belén de los Andaquíes, (MUSENUV); Balcanes, (MUSENUV). HUILA: Garzón, Vda. el Espinal, (IAavH). MAGDALENA: PNN Sierra Nevada de Santa Marta, El Ramo, 2500 m (IAvH); PNN Sierra Nevada de Santa Marta, San Pablo-San Pedro, 755 m, (IAvH). META: PNN Sierra de la Macarena, Caño Curía, 460 m (IAvH); 493 m, (IAvH). NARIÑO: RN La Planada, 1850 m, (IAvH). QUINDÍO: Alcalá, Los Guayabos, 1054m, (MUSENUV); Buenavista, Vda. El Infierno, Fca. Guadalajara, 1160 m, (IAvH); Calarcá, Vda. Pradera Baja, 1575 m, (IAvH); Calarcá, Vda. Santo Domingo, 1580 m, (IAvH); Circasia, Vda. Buenavista, Fca. Calamar, 1450 m, (IAvH); Génova, Vda. el Cedral, Fca. Buenos Aires, 1600 m, (IAvH); Génova, Vda. el Cedral, Fca. Venecia, 1800 m (IAvH); Génova, Vda. el Dorado, 1500 m, (IAvH); Génova, Vda. el Dorado, 1800 m, (IAvH); Génova, Vda. el Dorado, 1600 m, (IAvH); Montenegro, La Pampa, 1185 m, (MUSENUV); Quimbaya, Vda. el Laurel, Fca. Balmoral, 1200 m, (IAvH). TOLIMA: Fresno, 1508 m, (IAvH). VALLE DEL CAUCA: El Cairo, Vda. Buenos aires, Fca. el Pital, 1380 m, (IAvH); PNN Los Farallones de Cali, Anchicaya, 650 m, (IAvH). VICHADA: Cumaribo, Selva de Matavén, 260 m, (IAvH).

Linepithema piliferum

Distribution. *Linepithema piliferum* appears to be mainly a montane species (Wild 2007). It is widely distributed along the Andean mountain system; 95% of records were over 1500 m (0–2800 m). *L. piliferum* was previously recorded in the departments of Antioquia, Cauca, Chocó, Huila, La Guajira, Nariño, Quindío, Risaralda, Tolima, and Valle del Cauca (Wild 2007; Vergara-Navarro & Serna 2013); here we expand the distributional records to the departments of Boyacá, Caldas, Caquetá, Cundinamarca, Norte de Santander, and Putumayo (Fig. 3).

Biology. *Linepithema piliferum* was found in plantations of *Eucalyptus*, beans, coffee, pine, oak, and urapán (*Fraxinus chinensis* Roxburgh), as well as in mixed Andean forest, paddocks, forest fragments, forest edges, living fences, pastures, and glens.

Examined material. ANTIOQUIA: Medellín, San Pablo, 6°34’60N 75°15’0W, 1400 m (MZSP); Medellín, 1800 m (MZSP). BOYACÁ: Santa María, Vda. Caño Negro, 855 m (ICN). CALDAS: Aguadas, Arenillal,1400 m, Cañon Río Arma, 1995 m, La Herencia, 1890 m, La Playa, 1610 m, Puente Albania, 2220 m, Quebrada los Frailes, 2495 m, Quebrada Tarcará, 2395 m, Quebrada Frailes, 2495 m, Rio Aures, 700 m (IAvH); Aranzazu, Vda. Buena Vista Naranjal, Fca. la Palma, 2025 m, Fca. La Esperanza, 1930 m, Fca. la Bizerta, 2065 m, Fca. la Herradura, 2020 m, Vda. Chambery, Fca. Las Garzas, 1980 m, Fca. Maranduba, 2050 m, Vda. El Edén, Fca. el Billar, 2030m, Fca. El Crucero, 1605 m, Vda. la Guaira, Fca. Villa Ofelia, 1965 m, Fca. Chambery, 1940m, Fca. Alto Bonito, 2056m, Vda. Sabana Larga, Fca. las Colinas de Zega, 2000m, Vda. San José, Fca. el Montier, 2060m, Fca. Santa Teresa, 2005m (IAvH); Norcasia, Vda. San Roque, 160–220 m (IAvH). CAQUETÁ: Balcanes, (MUSENUV); Belén de los Andaquies, (MUSENUV). CAUCA: Popayán, Vda. la Rejolla, Fca. Helechaux, 1730 m (IAvH). CUNDINAMARCA: Fusagasuga, 1863 m (ICN). NORTE DE SANTANDER: Cucutilla, Vda. Carrizal, 2040–2200 m (IAvH). NARIÑO: Ricaurte, La Planada, 1800 m (IAvH). PUTUMAYO: PNN La Paya, 330 m (IAvH); Sibundoy, 2100 m (IAvH).QUINDÍO: Aranzazu, Vda. Buenavista, Fca. la Herradura, 2020 m (IAvH); Buenavista, Vda. el Infierno, 1160 m (IAvH); Calarcá, Vda. Pradera Baja, Fca. La Holanda, 1575 m (IAvH); Filandia, Vda. Cruces, Fca. Agua Bonita, 1870 m (IAvH), Fca. Aranjuez, 1750 m (IAvH), Fca. El Brasil, 1850 m (IAvH), Fca. el Palacio, 1810 m (IAvH), Fca. El Roble, 2050 m (IAvH), Fca. La Cha, 1920 m (IAvH), Fca. La Chena, 1820 m (IAvH), Fca. Los Micos, 1800 m (IAvH), Fca. Normandia, 2000 m (IAvH), Fca. Paraiso, 1800 m (IAvH), Fca. Pavas, 1900 m (IAvH), Fca. Realico, 1790 m (IAvH), Fca. Santa Clara, 1970 m (IAvH), Fca. Tesorito, 1990 m (IAvH), Fca. Veracruz 2010 m (IAvH); Génova, Vda. el Cedral, Fca. Buenos Aires, 1600 m (IAvH), Fca. Venecia, 1800 m (IAvH), Vda. el Dorado, Fca. San Isidro, 1500 m (IAvH); Pijao, Vda. la Playa, Fca. la Italia, 1800 m (IAvH); Quimbaya, Vda. la Española, 1100 m (IAvH). RISARALDA: Apia, Monteverde, 440 m (MUSENUV); Pereira, Vda. El Manzano, Fca. Cartón, 2110 m (IAvH), Fca. El Parnaso, 1940 m (IAvH), Fca. Santa Isabel, 1950 m (IAvH), Vda. La Suiza, 1810 m (IAvH), Vda. Yarumal, Fca. El Cedral, 1840 m (IAvH); Santa Cecilia, 588 m (ICN); Santa Rosa de Cabal, Vda. Campo Alegrito, 2490 m (IAvH); Santuario, Vda. Los Planes, Fca. La Delicias, 2000 m (ICN), SFF Otún Quimbaya, 1980 m (IAvH). VALLE DEL CAUCA: Buenaventura, El Salado, 0 m (ICN); Cairo, Vda. Buenos Aires, Fca. El Pital, 1380 m (IAvH), Vda. Vallecitos, Fca. El Pital, 1380 m (IAvH), Fca. la Fenicia, 1700 m (IAvH); Calima, 1211 m (IAvH); La Cumbre, Corregimiento Bitaco, 2115 m (IAvH); Peñas

Blancas, Alto Río Cali, (ICN); PNN Los Farallones de Cali, Anchiyaca, 900 m (IAvH); San Cipriano, 127 m (IAvH).

Linepithema tsachila

Distribution. *Linepithema tsachila* was recorded in the departments of Chocó and Valle del Cauca in East and Southeast of the country (Wild 2007); in this work, we expand the distributional records to the department of Nariño (Fig. 3).

Biology. *Linepithema tsachila* ranges from 286–1800 m and has been collected in very humid tropical forest and very humid premontane forest.

Examined material. NARIÑO: Barbacoas, Tajadas, 1°39'21"N 78°9'55"W, 1000 m (IAvH); El Diviso, 520 m (IAvH); Ricaurte, La Planada, 1800 m (IAvH). VALLE DEL CAUCA: Bajo Anchicayá (IAvH).

General discussion

Colombia has an important and high diversity of ants, hosting more than 83% of the ant genera reported to South America (Ward 2016). In the Americas, Brazil has the highest species richness for *Linepithema*, with 10 of the 20 known species, followed by Colombia with eight. Five species in Brazil are shared with Colombia (*L. angulatum*, *L. gallardoi*, *L. humile, L. iniquum*, and *L. neotropicum*), while the other five are restricted to Brazil or other neighboring countries.

In Colombia, *Linepithema* occurs in the Amazonian, Andean, Caribbean, Orinoquia and Pacific natural regions. With this work, we increase the records to 22 of the 32 departments, reporting the genus for the first time in the departments of Caldas, Cesar, Norte de Santander, Santander, and Vichada. The genus *Linepithema* has a mainly Neotropical distribution. Some species are geographically very restricted, such as *L. cerradense* Wild (associated with the Cerrado habitat from Bolivia, Paraguay and Brazil), but others, such as *L. angulatum*, *L. neotropicum,* and *L. piliferum*, are widely distributed in the Neotropical region (Wild 2007). This pattern holds in Colombia, where these latter species are found in many of the departments.

The Colombian departments with the highest species richness are Caldas, Quindío, and Valle del Cauca, which partially encompass the Colombian Andes. Other mountain formations such as the Sierra Nevada de Santa Marta and the Serranía del Perijá, in the north of the country, have favorable conditions for *Linepithema,* hosting multiple species, including *L. dispertitum*, *L. iniquum,* and *L. neotropicum*. Presumably, this is due to the climate, where temperatures are similar to those of the subtropical region of South America, the zone where the genus *Linepithema* probably evolved (Wild 2009). A similar pattern is observed in the doryline genus *Leptanilloides*, which has highest richness at high elevations in the Andes (Brandão *et al*. 1999, Delsine *et al*. 2015). On the other hand, the relatively poor representation of the genus in some lowland regions such as Amazonia and Oriniquia may be due to undersampling.

Sympatry in the Colombian *Linepithema* species was found. Cases include *L. gallardoi* and *L. neotropicum* in the Santuario de Flora y Fauna de Iguaque, Boyacá; *L. angulatum, L. neotropicum* and *L. piliferum* in Aguadas, Caldas; and *L. angulatum* and *L. piliferum* in the department of Risaralda. Mera *et al*. (2010) recorded *L. neotropicum* along with *L. angulatum* in the township of Pescador, town of Caldono (Cauca), interacting in coffee crops with other insects from the orders Coleoptera, Dermaptera, Hemiptera, and Hymenoptera.

Even if the presence of *L. humile* (the Argentine ant) in Colombia is uncertain, other species of the genus, such as *L. piliferum*, *L. neotropicum* or *L. angulatum*, have the potential to be pests. These species have wide geographical distributions and are commonly found interacting with aphids and other insects (Mera *et al*. 2010) that may be a threat to agricultural activities. In such scenario, natural history collections have an important role in documenting potential biological threats to economic activity and local biodiversity (Suarez & Tsutsui 2004).

In the last decade, the research on the subfamily Dolichoderinae in Colombia has led to new generic records, new species descriptions, and taxonomic clarifications of the subfamily and genera (Fernández & Guerrero 2008; Guerrero & Fernández 2008; Guerrero *et al*. 2010; Guerrero & Sanabria 2011; Cuezzo & Guerrero 2012). These contributions highlight the importance of continuing research in the systematics and taxonomy of ants and other

zoological groups, and particularly the relevance of thorough reviews of selected groups (Sangster & Luksenburg 2015).

Acknowledgments

We are thankful to the curators of Instituto de Ciencias Naturales (Universidad Nacional de Colombia), Museo de Entomología de la Universidad del Valle, Instituto Alexander von Humboldt and Centro de Colecciones Biológicas de la Universidad del Magdalena for allowing access to specimens of *Linepithema*. Thanks to William P. Mackay for loaning specimens of *Linepithema humile* from Colombia. We are especially grateful to John T. Longino, Phillip S. Ward, Brendon Boudinot, Paula Sepúlveda, and two anonymous referees for valuable comments on the content and english revision and improvement. This is a contribution # 01 of the research project "Systematics and Evolution of the Ant Genus *Tapinoma* Föerster (Formicidae: Dolichoderinae) in the Neotropical Region" supported by Colciencias-Universidad del Magdalena through agreement #008-2015.

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