Zootaxa 1958: 51–60 (2008)
www.mapress.com/zootaxa/

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

A new species of the ant genus *Forelius* (Formicidae: Dolichoderinae) from the dry forest of Colombia

ROBERTO J. GUERRERO[1] & FERNANDO FERNÁNDEZ[2]

[1]*Grupo de Investigación en Insectos Neotropicales, INTROPIC, Universidad del Magdalena, Santa Marta, Magdalena, Colombia. E-mail: rguerrero@unimagdalena.edu.co*
[2]*Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado 7495, Bogotá D.C., Colombia. E-mail: ffernandezca@unal.edu.co*

Abstract

Forelius damiani **sp. nov.** is described from the dry forest of the Sierra Nevada de Santa Marta, Colombia, and additional collections from Costa Rica and Texas (USA). This new species is separated from the other rounded spiracles *Forelius* by the number of erect pronotal hairs, size and coloration. Comments and hypotheses about the biogeography of the genus are provided. *Forelius pruinosus* is recorded for the first time for Colombia.

Key words: Ants, *Forelius*, Neotropical region, taxonomy, Colombia

Resumen

Se describe a *Forelius damiani* **sp. nov.**, del bosque seco de la Sierra Nevada de Santa Marta, Colombia; esta especie también se encuentra en Costa Rica y Texas (Estados Unidos de Norte América). Esta nueva especie puede separarse de las otras *Forelius* con espiráculo redondeado, por el número de pelos erectos en el pronoto, tamaño y la coloración. Además, se presentan comentarios e hipótesis sobre la biogeografía del género *Forelius*. La especie *Forelius pruinosus* es registrada por primera vez para Colombia.

Palabras clave: Hormigas, *Forelius*, región Neotropical, taxonomía, Colombia

Introduction

Ants of the genus *Forelius* Emery 1888 are a component of the arid and semiarid ant fauna of the New World (Cuezzo 2000). *Forelius* has an apparently amphitropical distribution in North and South America (Shattuck 1992), occurring from the southern part of the United States to Panama and from northeastern Brazil to southern Argentina (Cuezzo 2000). Most species occur in the southern part of the range, from coastal and southern Brazil to Patagonia, and relatively few species occur in the northern part of the range, in Mesoamerica and the southern United States (Shattuck 1992, Cuezzo 2000, Ward 2005). In general, all species of *Forelius* inhabit dry and open areas and are seldom found in forested or moist sites.

Cuezzo (2000) revised the genus delimiting 18 species, offering distribution maps and a key to species. Recently Ward (2005) proposed *F. analis* as a junior synonym of *F. pruinosus*. In this paper, we report the first record of the genus *Forelius* in Colombia, with the description of a new species, *Forelius damiani* Guerrero & Fernández **sp. nov.** and the first record of *F. pruinosus* in Colombia. A revised key to known species with rounded spiracles is also provided.

Accepted by J. Longino: 29 Oct. 2008; published: 8 Dec. 2008

Methods

Observations of pinned specimens were made using a Nikon SMZ645 stereomicroscope at 80X magnification and an optic fiber ring lamp. Scanning Electron Microscope (SEM) photographs of *Forelius damiani* were obtained from two specimens at the MZSP in São Paulo, Brazil. The specimens were previously cleaned in acetone, critical point dried in a Balzer (Bal-TecH CPD 030), and sputter coated with gold (Bal-TecH SCD 050). Specimens were mounted on metallic triangles using silver glue and then affixed to stubs for the electron microscopy. The images were obtained under several magnifications (150 to 300x), according to the size of the specimens or structure observed. Finally, the images were edited (Corel Photo–Paint X3 version 13.0®) to enhance some brightness and contrast details.

Measurements follow Cuezzo (2000) using an ocular micrometer at 80x. All of the following measurements are expressed in millimeters:

TL	Total length. In lateral view, taken from anterior clypeal margin (excluding mandibles) to apex of last segment of metasoma.
HL	Head length. Maximum length, in full face view, from apex of clypeal plate to middle of posterior vertex margin.
HW	Head width. Maximum width in full face view excluding eyes.
EL	Eye length. Maximum length of eye in full face view.
EW	Eye width. Width of eye perpendicular to maximum length.
IOD	Distance between inner-most edges of eyes measured in full face view.
COD	clypeus-ocular distance. Shortest distance between posterior margin of clypeus and anterior margin of eye.
SL	Scape length. Maximum length of first antennal segment, excluding neck and basal condyle.
PSL	Propodeal spiracle length. Maximum length of propodeal spiracle.
PSW	Maximum width of propodeal spiracle perpendicular to maximum length.
ISPD	Inter-spiracle distance, across propodeum. Taken with body in dorsal view.
PL	Petiolar length. Maximum length of petiole. Taken with body in lateral view.
PHM	Maximum petiolar height. Taken with body in lateral view.
MsL	Mesosoma length. Straight-line distance measured in lateral view from anterior margin of pronotum (excluding collar) to posterior extremity of metapleural lobe.

Indices

CI Cephalic index: (HW/HL)*100
OI Ocular index: (EL/EW)*100
SI Scape index: (SL/HW)*100

Collections. Specimens used in this study have been deposited in the following collections:

BMNH	Natural History Museum, London, England.
CASC	California Academy of Sciences, San Francisco, California, USA
CEUM	Insect Collection of University of Magdalena, Santa Marta, Colombia.
CPDC	Coleção de Formigas do Centro de Pesquisas do Cacau, Comisão do Plano de Lavoura Cacueira, Itabuna, Bahia, Brazil.
CWEM	William and E. Mackay Insect collection, University of Texas, El Paso Texas, USA.
IAvH	Insect Collection, Instituto Humboldt, Claustro San Agustín, Villa de Leyva, Boyacá, Colom-

	bia.
ICN	Insect Collection, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá D.C., Colombia.
IFML	Instituto-Fundación Miguel Lillo, Universidad Nacional de Tucumán, Argentina.
JTLC	John T. Longino Collection, Evergreen State College, Washington, USA.
LACM	Los Angeles County Museum of Natural History, Los Angeles, USA.
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, USA.
MIZA	Instituto de Zoología Agrícola, Facultad de Agronomía, Universidad Central de Venezuela, Maracay, Venezuela.
MZSP	Museu de Zoologia, Universidade de São Pãulo, Brazil.
PSW	Philip S. Ward Collection, University of California, Davis, USA.
USNM	United States National Museum of Natural History/Smithsonian Institution, Washington D.C.

Coordinates of localities were obtained from the information on the specimen labels and in some cases from the field notes of P. S. Ward (for all specimens not seen). The geographic coordinates were plotted on a distribution map generated by the software ArcView 3.2®.

Results

Forelius damiani Guerrero & Fernández sp. nov.

(Fig. 1, 2 & 3)

Worker measurements. Holotype. TL 1.56, HL 0.48, HW 0.38, EL 0.10, EW 0.08, IOD 0.24, COD 0.10, SL 0.40, PSW 0.01, PSL 0.01, ISPD 0.10, PL 0.10, PHM 0.08, MsL 0.44, CI 79, OI 125, SI 105.

Paratypes and non types (n= 38): TL 1.40 – 1.68, HL 0.42 – 0.50, HW 0.36 – 0.42, EL 0.10 – 0.12, EW 0.08 – 0.10, IOD 0.22 – 0.32, COD 0.04 – 0.10, SL 0.36 – 0.44, PSW 0.01 – 0.02, PSL 0.01 – 0.02, ISPD 0.10 – 0.16, PL 0.08 – 0.14, PHM 0.06 – 0.10, MsL 0.44 – 0.58, CI 79 – 90, OI 120 – 150, SI 95 – 132.

Worker diagnosis. Mandible with four teeth and two denticles. Pronotum in profile relatively low and flat, with 2 erect setae. Dorsum of mesonotum and propodeum with very fine punctation. Mesopleural and metapleural regions shining, with sparse pubescence. Propodeal spiracle circular $\leq$ 0.02 mm diameter.

Worker description. Head flattened dorsoventrally, longer than wide (full face view). Vertex of head weakly concave. Palpal formula 6:4. Anteromedial clypeal plate with shallow concavity and long, ventrally curved setae about same length as closed mandibles. Clypeal margin with a long median seta and two long lateral setae projecting forward. Long erect seta on middle inner margin of each torulus; long seta behind each torulus. Scape short, reaching posterior margin of head. Mandible with apical tooth elongate, twice as long as subapical tooth; subapical tooth followed by a denticle, a tooth, another denticle, and a basal tooth separating masticatory margin from basal margin. Mesosoma (lateral-view) straight with slight mesonotal groove. Mesonotum and propodeum with decumbent scattered pubescence; very fine punctuation on dorsum of mesonotum and dorsum of propodeum. Mesopleuron and metapleuron shining, with sparse pubescence. Propodeal spiracle circular. Posterior face and dorsal face of propodeum convex; dorsal face longer than posterior face. Outer face of anterior coxa with two setae; proximal seta longer than distal seta; inner face of middle and posterior coxae with distal setae; femora and tibiae with dense pilosity. Scale present and strongly inclined anteriorly; petiolar spiracle at base of scale. Dorsum of gaster with abundant pubescence; first gastric (third abdominal) tergite without setae, second gastric tergite bearing 2 setae, third gastric tergite bearing 4 setae and fourth tergite bearing 6 setae. Head and mesosoma dark brown; gaster, petiole, legs, scape and mandible light brown; teeth of mandibles slightly darker than mandible; funicular segments darker than scape.

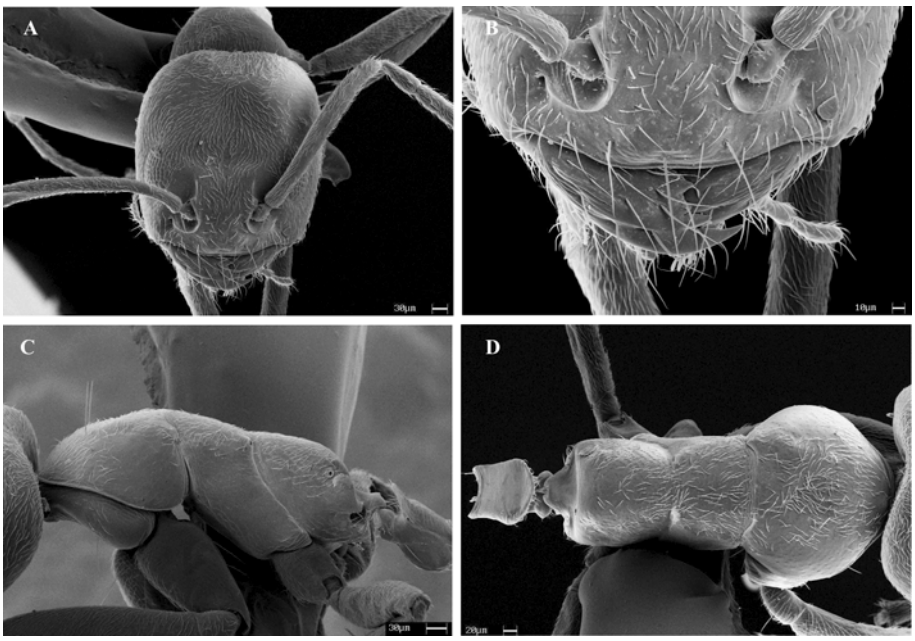

FIGURE 1. SEM is of *Forelius damiani*. a. Head in full face view. b. Clypeus. c. Mesosoma in lateral view. d. Mesosoma in full dorsal view.

FIGURE 2. *Forelius damiani* from Colombia. a. Head in full face view. b. Body in lateral view. Images CASENT0178238, photographer: April Nobile.

Queen and male. Unknown

Holotype worker. **Colombia**: Magdalena; Santa Marta; Vda. Mosquito; 11°10'23.6" N 74°10'45" W 96 m; pitfall; 24-26.Feb.2007; D. Ramírez, coll. Deposited in ICN Insect Collection, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, (Bogotá D.C., Colombia). Paratypes: 22 workers, all from the same locality and date as the Holotype, deposited in BMNH (1w), CASC (4w), CEUM (2w), CWEM (1w), CPDC

(1w), IAvH (2w), ICN (2w), IFML (2w), JTL (1w), LACM (1w), MCZ (1w), MIZA (1w), MZSP (1w), PSW (1w), USNM (1w).

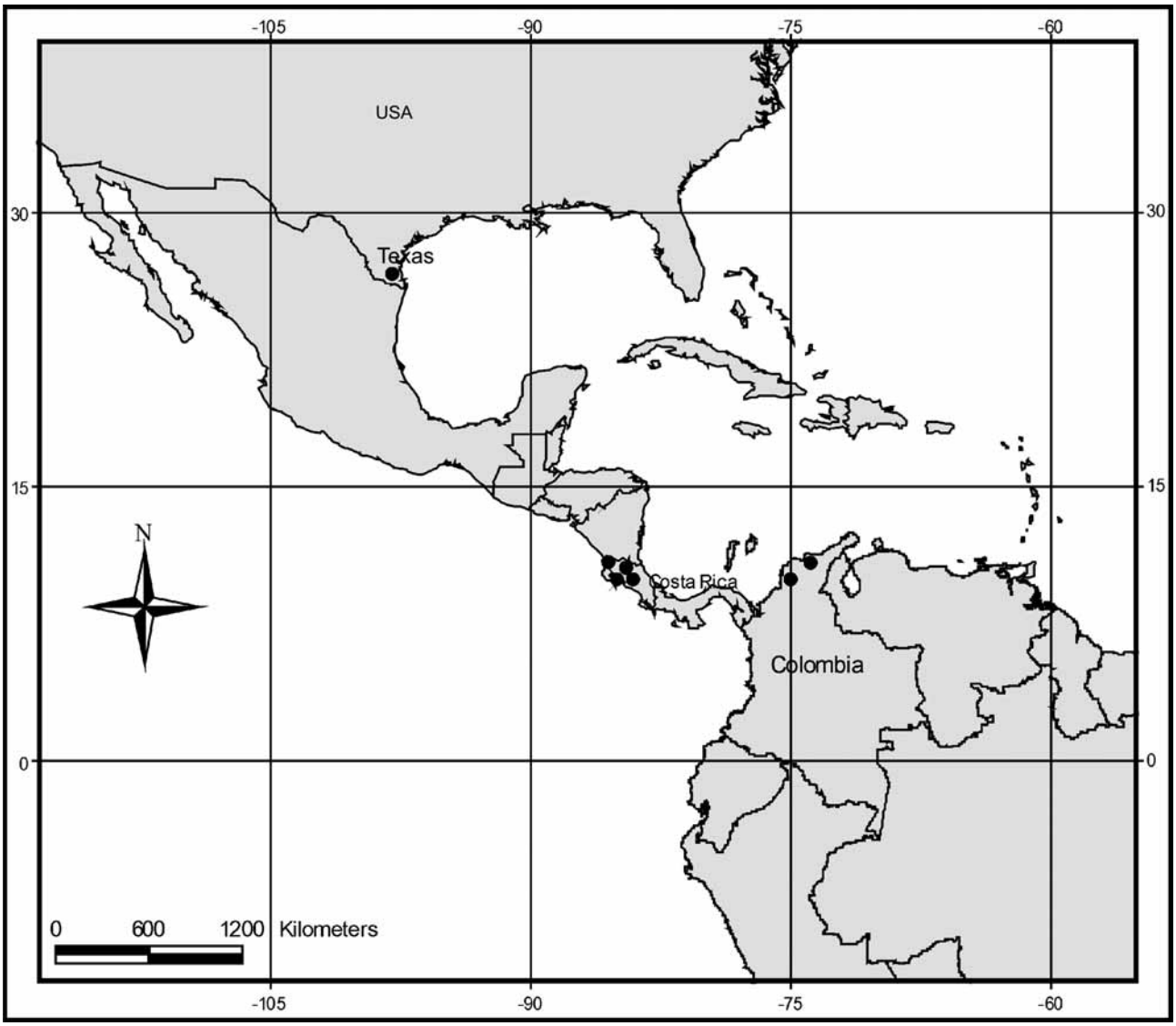

FIGURE 3. Distribution of *Forelius damiani* **n. sp.** Guerrero & Fernández.

Additional material examined: Colombia: (10w), Bolívar; Zambrano; Hda. Monterrey; 9°45' N 74°49' W 70 m; pitfall; 01.Aug.1993 F. Fernández & G. Ulloa, coll. **Costa Rica**: (3w), Guanacaste; 10º48'N 85º41'W; 100 m; at tuna bait; 14.Jun.1985; xeric scrub on rocky ridge; J. Longino, coll. [LACM ENT 141815]. (1w), Guanacaste; Santa Elena Peninsula; 10° 53'N 85° 45'W; 08.May.2002; J. M. Jacobs, coll. [JTLC000009256]. (1w), Guanacaste; 8km S Santa Cecilia; 10º59'N 85º26'W; 650 m; 24.Jan.1991; Wet forest. Strays; J. Longino, coll. [INBIOCRI001282672]. (1w), Heredia; La Selva Biological Station; 10º26´N 84º01´W; 01.May.1994; J. Longino, coll. [INBIOCRI001260978]. (1w), Puntarenas; Pita; 10º10'N 84º55'W; 200 m; Sweep sample of roadside vegetation; 13.Jul.1984; J. Longino, coll. [LACM ENT 141813].

Specimen records provided by P. S. Ward (pers. comm.): **Costa Rica**: Guanacaste; 1km E Playa Nancite; PN Santa Rosa; 10º48'N 85º41'W; 100 m; 5.Apr.2000; Low, open tropical dry forest, in gully, on serpentine; On trail between Playa Naranjo and Playa Nancite, within the watershed of Quebrada Nancite. P. Ward, coll. **USA**: Texas. Cameron Co. Resaca de la Palma State Park. 25º59'N 97º34'W; 10m; 16.Apr.2006; Subtropical thorn woodland; P. Ward, coll.

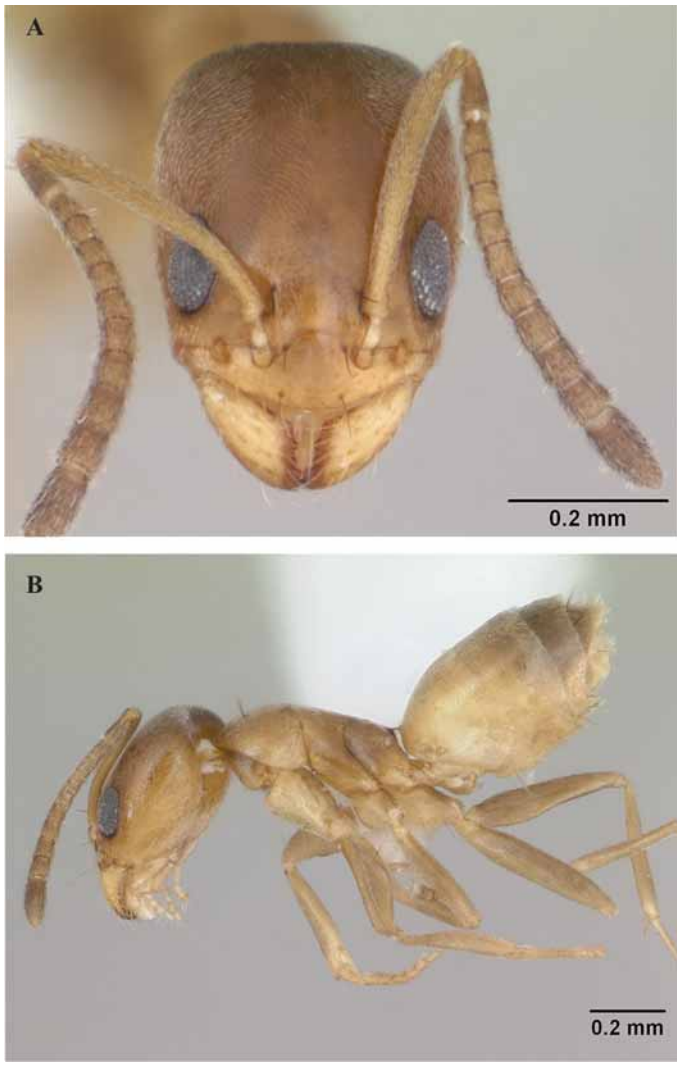

FIGURE 4. *Forelius pusillus* from Paraguay. a. Head in full face view. b. Body in lateral view. Images CASENT0173739, photographer: April Nobile.

Geographic distribution: Colombia (Magdalena, Bolívar), Costa Rica (Guanacaste, Heredia and Puntarenas), USA (Texas).

Etymology: The species name honors our colleague and friend Damian Ramírez, who collected and loaned the ants from his thesis research.

Natural History: *Forelius damiani* n. sp. was collected in lowland dry forest of the Sierra Nevada de Santa Marta, a tropical forest with an open canopy dominated by *Bursera simaruba* (L.) Sarg. (Burseraceae), *Bursera glabra* (Jacq.) Triana & Planch and *Pereskia colombiana* Britton & Rose (Cactaceae). The habitat is subjected to occasional human disturbance resulting from the extraction of timber. It was also collected in the dry forest of Zambrano (Bolívar, Colombia), but we have no specific information about floristic composition from this site. However, this locality is a transition zone between gallery forest and tropical dry forest. This species is restricted to lowland forest and scrub vegetation, from sea level to 650 m elevation.

The specimens from Costa Rica were collected in open tropical dry forest, xeric scrub, and synanthropic habitats in wet forest areas. Although the genus is generally adapted to dry climates, this species can extend into wet climate areas in the presence of frequent human disturbance.

Although no complete nest of *F. damiani* has been collected, the large number of specimens collected from the type locality with only one pitfall trap (150 workers) indicates that its colonies could be composed of more than one hundred workers, foraging in large numbers.

FIGURE 5. *Forelius mccooki* from USA. a. Head in full face view. b. Body in lateral view. Images CASENT0005322, photographer: April Nobile.

***Forelius pruinosus* (Roger 1863)**
(Fig. 6)

Material examined: Colombia. (3w), Magdalena; Santa Marta; Vda. Mosquito. 11°10'23.6"N 74°10'45"W 96 m; Manual collection; 03.Jan.2008; D. Olivero & M. Escárraga, coll. Deposited in Insect Collection of University of Magdalena (CEUM), Santa Marta, Colombia.

Geographic distribution: Bahamas, Colombia (Magdalena), Costa Rica (Guanacaste), Cuba, Guatemala, Mexico, Panama, The West Indies, USA [Arizona, California, Florida, Georgia, Missouri, North Dakota (Wheeler & Wheeler 1963), Texas].

Cuezzo (2000) provided a taxonomic key for all species of *Forelius* known. Due to the new synonymy between *F. analis* and *F. pruinosus* (Ward 2005) and the description of *F. damiani*, we provide a new key for the species with circular propodeal spiracle, with the exception of *F. keiferi*. The descriptions of *F. keiferi* and *F. pruinosus* given in Cuezzo (2000) overlap in many characters and the status of *F. keiferi* as a species distinct from *F. pruinosus* is not certain.

FIGURE 6. *Forelius pruinosus* from Costa Rica. a. Head in full face view. b. Body in lateral view. Images PSW14182-1, photographer: April Nobile.

Key to species of *Forelius* Emery with spiracles rounded [based on workers; modified from Cuezzo (2000)]

1. Small workers (TL 1.6 – 1.7 mm). Scapes barely reaching vertex margin (SI < 90). Mesosomal outline always continuous in lateral view. (Argentina, Brazil, Paraguay)..... *pusillus* (Santschi) (Fig. 4)
- Worker size variable (TL 1.4 – 2.5 mm). Scapes reaching or surpassing vertex margin by at least 1/6 of their length (SI > 90). Mesosomal outline variable 2
2. Pronotum bearing only two erect setae. Dorsal face of propodeum lacking erect setae. (Colombia, Costa Rica, USA).....*damiani* **sp. nov.** (Fig. 1 & 2)
- Pronotum bearing more than two erect setae. Dorsal face of propodeum bearing erect setae. Note: Some evidence of intergradation between *F. pruinosus* and *F. mccooki* (Ward 2005) suggests that *F. pruinosus* may contain a number of cryptic species, and may also hybridize with the very similar *F. mccooki* 3
3. Mandibles with four teeth and three to four denticles. Pronotum usually with six erect setae. Dorsal face of mesosoma bearing more than 10 erect setae. (Jamaica, Mexico, USA) .....*mccooki* (McCook) (Fig. 5)
- Mandibles with five teeth and one or two denticles. Pronotum usually with four erect setae. Dorsal face of

mesosoma bearing 2 to 6 erect setae. (Bahamas, Colombia, Costa Rica, Cuba, Guatemala, Jamaica, Mexico, Nicaragua, Panama, USA)..... *pruinosus* (Roger) (Fig. 6)

Discussion

Forelius damiani and *F. pruinosus* are the first species of the genus *Forelius* known from Colombia. Both species have been collected in the lowland dry forest of the Sierra Nevada de Santa Marta while *F. damiani* has also been collected in Zambrano (Bolívar), northern Colombia. The Zambrano specimens do not differ from those of the type locality. The workers of *F. damiani* from Costa Rica differ somewhat in size (TL 1.50 – 1.68 mm in Costa Rica vs. TL 1.40 – 1.58 mm in Colombia) and the length of the scapes (exceeding the vertexal margin by 0.04 mm in Costa Rica, not exceeding the vertexal margin in Colombia). While the TL of the workers showed differences between the populations of Costa Rica and Colombia, the length of mesosoma is less variable and the measurements for the two countries broadly overlap (MsL 0.46 – 0.56 mm in Costa Rica vs. MsL 0.44 – 0.58 mm in Colombia). Specimens from Costa Rica are darker brown than those from Colombia.

Forelius damiani is relatively similar to *F. pruinosus* (Roger), but *F. damiani* has only two erect pronotal hairs while *F. pruinosus* can have two to four erect pronotal hairs; the promesonotum of *F. damiani* is lower compared with *F. pruinosus*; the dorsal face of the propodeum is longer than the declivitous face in *F. damiani*, moreover it lacks propodeal hairs; and *F. damiani* is smaller than *F. pruinosus* in some measurements such as TL, HL, HW and SL (see measurements above and Cuezzo (2000) for comparison). *Forelius damiani* is similar to *F. pusillus*, however several characters show differences: the mandibles of *F. damiani* have four teeth while those of *F. pusillus* have five; the propodeum of *F. pusillus* has four conspicuous setae but *F. damiani* has none; the workers in *F. pusillus* are a little larger (TL 1.6 – 1.8 mm in *F. pusillus* vs. 1.40 – 1.68 mm in *F. damiani*). Characters that distinguish *Forelius damiani* from most other *Forelius* species are the circular propodeal spiracle and the absence of erect hairs on the dorsal face of the propodeum.

The occurrence of round spiracles on the new species *F. damiani* reinforces a pattern in which the few species found north of the Amazon basin all have round spiracles, while south of the Amazon many species have elongate, slit-like spiracles and only one species has round spiracles. Several hypotheses can explain this pattern, based on whether round spiracles are plesiomorphic, apomorphic, or homoplasious in the genus. If round spiracles are plesiomorphic, the genus could have originated north or south of the Amazon basin and then dispersed across the Amazon (perhaps during a period of drier climate). Subsequently, elongate spiracles evolved in the south (as one adaptation to arid conditions, reducing water loss through the spiracle) and perhaps allowed a greater diversification there. In the south, forms with elongate spiracles may have displaced previously more abundant and diverse forms with round spiracles. Alternatively, round spiracles could be apomorphic. An initial radiation of forms with elongate spiracles may have occurred in southern South America. Subsequently, a form with round spiracles evolved which was better suited to humid conditions and better able to cross the Amazon Basin. Once on the other side it diversified into the present species found north of the Amazon. Finally, round spiracles could be homoplasious, evolving independently north and south of the Amazon. Further phylogenetic work on the genus is needed to differentiate among these hypotheses.

Acknowledgments

We thank Damian Ramirez (Research Neotropical Insects Group), Mónica Ospina and Diego Perico (IAvH) for the loan of material. We appreciate Alex Wild and Fabiana Cuezzo for their confirmation of the genus and critical comments that improved the manuscript. We thank Lyncoln de S. Ferrara for help with pinned specimens and Lara M. Guimarães-Silveira, technician of MZSP SEM who took the scanning electron micro-

graphs; and Beto Brandão for permitting us to work in the MZSP. Brian Fisher and April Nobile provided Automontage images. Many thanks to Phil Ward who shared his field notes and provided information on specimens of *F. pruinosus* and *Forelius damiani* from Texas. Jack Longino loaned ants from Costa Rica and USA and provided critical comments that enriched the manuscript. We are in debt to Bill Mackay and Barry Bolton for their great help with the English and comments to the manuscript. This work was supported by *Jóvenes Investigadores* Program of COLCIENCIAS - University of Magdalena agreement # 122 to RJGF. The first author thanks Movilidad Internacional Program of COLCIENCIAS and University of Magdalena for support of the visit to the MZSP.

References

Cuezzo, F. (2000) Revisión del género *Forelius* (Hymenoptera: Formicidae: Dolichoderinae). *Sociobiology*, 35, 197–277.

Emery, C. (1888) Über den sogenannte Kaumagen einiger Ameisen. *Zeitschrift für Wissenschaftliche Zoologie*, 46, 378–412.

Roger, J. (1863) Die neu aufgeführten Gattungen und Arten meines Formiciden-Verzeichnisses nebst Ergänzung einiger früher gegebenen Beschreibungen. *Berliner Entomologische Zeitschrift*, 7, 131–214.

Shattuck, S. O. (1992) Generic revision of the ant subfamily Dolichoderinae. *Sociobiology*, 21, 1–181.

Ward, P.S. (2005) A synoptic review of the ants of California (Hymenoptera: Formicidae). *Zootaxa*, 936, 1–68.

Wheeler, G.C. & Wheeler, J. (1963) *The Ants of North Dakota*. University of North Dakota Press, North Dakota, 326 pp.