



Two new species of *Leptogenys* from southern Brazil (Hymenoptera: Formicidae)

ROMÁN A. LÓPEZ-MUÑOZ¹, ERICK VILLARREAL¹ & JOHN E. LATTKE^{1,2}

¹Departamento de Zoologia, Universidade Federal do Paraná, Caixa Postal 19020, 81531-980, Curitiba, Paraná, Brazil.

E-mails: captandognomas@gmail.com; Erick.cvf@gmail.com; piquihuye@gmail.com

²Corresponding author

Abstract

Two new species of ants belonging to the genus *Leptogenys* are described: *L. academica* n. sp., and *L. carioca* n. sp., both belonging to the *crudelis* group. The former species is known from the city of Curitiba while the other species occurs in montane forests of the Itatiaia Plateau. We provide descriptions based on the worker caste, images, as well as a modification of the key presently used for identifying the New World workers of *Leptogenys*.

Key words: urban biodiversity, morphology, endemism, Atlantic Forest, montane forest

Introduction

The genus *Leptogenys* Roger is found throughout the world's tropical and subtropical zones with over 300 known extant species (Bolton 2018). *Leptogenys* is the most species-rich genus within the subfamily Ponerinae and its members display a diversity of foraging strategies and reproductive systems that make it an ideal group for studying foraging and reproduction in the Ponerinae (Schmidt & Shattuck 2014). The difficult taxonomy has proved an obstacle for research on this group but recent taxonomic treatments are improving our knowledge of these ants. Lattke (2011) revised the New World fauna, Rakotonirina & Fisher (2014) revised the Malagasy fauna, Xu *et al.* (2015) reviewed the Oriental species, and Arimoto (2017) revised the *modiglianii* species group. Keys for the Indian fauna are found in Bharti & Wachkoo (2013) and keys for the *Leptogenys* of the Arabian Peninsula are found in Sharaf *et al.* (2017). Schmidt and Shattuck (2014) provide a succinct and excellent overview of the genus. Here we describe two new species, both from southern Brazil. Both key out in a similar place in Lattke's (2011) identification key for the New World species, with the potential of being misidentified as the more common species *L. cuneata* Lattke or *L. famelica* Mann. One of the species is unusual due to its preference for cool montane forests in a mostly lowland adapted group, while the other is remarkable for inhabiting the urban sprawl of the city of Curitiba. We provide images of the new species and point out morphological characteristics that permit distinguishing them from similar species.

Materials and methods

The acronyms used in this work for the specimen repositories represent the following institutions:

CASC—Entomological Collection of the California Academy of Sciences, San Francisco, California

DZUP—Coleção Entomológica Padre Jesus Santiago Moure of Universidade Federal do Paraná (UFPR) in Curitiba, Paraná, Brazil.

MZSP—Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil.

RBINS—Royal Belgian Institute of Natural Sciences, Entomology Collection, Brussels, Belgium

Photographs of the ants were obtained with a Leica DFC 500 camera coupled to a Leica MZ16 stereomicroscope and Leica IM 50 software (Image Manager). Focus stacking of the images was performed with Leica Auto-Montage Pro. Further editing was done using Adobe Photoshop CS6. Measurements were taken using a Zeiss SV6 fitted with an ocular micrometer (10x ocular lens) and are expressed in millimeters. Measurement and index definitions follow Lattke (2011).

HL:	Head length: mid-line length of the head capsule, measured in full-face (dorsal) view, from the anterior margin of the clypeus to the mid-point of a line drawn across the posterior margin.
HW:	Head width: maximum width of head, measured in the same plane as HL, excluding the eyes.
ML:	Mandible length: straight-line length of a mandible, measured from the lateral base at the insertion into the head capsule, to the apex. Measured in the same plane as HL.
EL:	Eye length: maximum length of the compound eye, in the same plane as HL.
SL:	Scape length: maximum length of the first antennomere, excluding the basal neck and condyle.
PW:	Pronotal width: maximum width of pronotum in dorsal view.
WL:	Weber's length of the mesosoma: diagonal length, measured in lateral view from the anterior margin of the pronotum (excluding the collar) to the posterior extremity of the propodeal lobe.
PH:	Petiole height: Height of the petiole measured in lateral view from the apex of the ventral (subpetiolar) process vertically to a line intersecting the dorsalmost point of the node.
PL:	The length of the petiole from the anterior process to the posteriormost point of the tergite, where it surrounds the gastral articulation.
PDW:	The maximum width of the petiole in dorsal view.
CI:	Cephalic index: HW/HL
MI:	Mandibular index: ML/HW
OI:	Ocular index: EL/HW
SI:	Scape index: SL/HW
LPI:	Lateral petiole index: PH/PL
DPI:	Dorsal petiole index: DPW/PL

Results

The two new species are in the *crudelis* species group. This group has the following characters (modified from Lattke, 2011: 151): Head longer than wide; eye diameter not more than one-third the length of lateral cephalic margin, eye weakly convex, dorsolaterally placed on head, circumocular sulcus absent; median clypeal lobe with lateral lamella, clypeal apex without setae, lateral clypeal lobe poorly developed; mandible shuts tight against clypeus, basal mandibular sulcus well developed; mandible subtriangular with basal and external margins either parallel or weakly diverging; sulcus between tentorial pit and antennal sclerite shallow, scape surpasses posterior cephalic margin by at least one-fourth its length; third antennal segment longer than neighboring basal funicular segments. Mesonotum wider than long, not narrow; metanotal groove smooth, not scrobiculate; metapleuropropodeal suture absent; declivitous propodeal margin shorter than dorsal margin in mesosomal lateral view, propodeum with lobe or tooth; petiolar node in lateral view subtriangular to subquadrate, distinct anterior margin present or absent; node longer than wide in dorsal view; anterodorsal margin of third abdominal segment convex in lateral view, constriction between abdominal segments III and IV well developed; metacoxa with low posterodorsal swelling; protibial apex lacking seta, mesotibial apex with single seta, metatibial apex with or without apical seta; body mostly with smooth and shining sculpture; appressed pubescence lacking, scattered standing hairs present on dorsum of body.

Leptogenys academica, n. sp.

urn:lsid:zoobank.org:act:6615CDA8-C9DE-4622-AF4C-59EE4400A348

Fig. 1

Worker diagnosis. With diagnostic features of the *crudelis*-group of species; distinguished from other species in

this group by the scrobiculate metanotal sulcus. Mesonotum forms low but distinct convexity in lateral view, metanotal sulcus scrobiculate or with at least 3–4 longitudinal costulae, propodeal teeth low and blunt, protibial strigil lacking accompanying translucent lobe (velum); petiolar node subtriangular in lateral view with convex anterodorsal margin.

Examined material. Holotype: Brazil, Paraná, Curitiba. Mata Viva, Centro Politécnico—UFPR. 21.I–18.III.2009. M. Mausselen. Pitfall. One point-mounted worker deposited in DZUP with *Numero de Tombo* (= unique specimen identifier) DZUP 548773. Paratypes: Five individually point-mounted workers, each with identical locality data as the Holotype, except for one worker, DZUP 548774 (which differs only in the sampling period, 15.X–10.XII.2008). This last worker is deposited in DZUP. The remaining four workers are to be deposited, one each, in the following institutions: DZUP 548775 in CASC, DZUP 548776 in MZSP, DZUP 548777 in RBINS, and DZUP 548778 in DZUP. The Mata Viva forest is located at -25.4463° -49.2338°, 925 m.

Worker dimensions, Holotype (Paratypes, n=5): HL 1.66 (1.56–1.63); HW 0.94 (0.89–0.97); ML 0.75 (0.66–0.75); EL 0.31 (0.28–0.31); SL 1.78 (1.69–1.78); PW 0.88 (0.83–0.91); WL 2.53 (2.47–2.72); PH 0.97 (0.88–0.97); PL 0.97 (0.94–1.00); DPW 0.53 (0.50–0.58). CI 0.57 (0.57–0.61); MI 0.80 (0.74–0.77); OI 0.33 (0.31–0.33); SI 1.90 (1.81–1.89); LPI 1.00 (0.90–0.97); DPI 0.55 (0.52–0.58).

Worker. Head elongate in dorsal view, wider anterad than posterad, lateral margin weakly convex, posterior margin (defined by occipital carina) weakly convex, median clypeal process triangular with blunt apex, lateral clypeal process narrow. Cephalic dorsum mostly smooth and shining with scattered punctulae, clypeus with coarse longitudinal striae. Eye dorsolaterally placed on head, weakly convex, eye length occupies less than one-fourth of lateral cephalic margin with head in frontal view. Scape densely punctate and projecting beyond posterior cephalic margin by one-fourth its length; length of pedicel slightly more than twice its greatest width; length of third antennomere more than three times its greatest width; length of fourth antennomere more than twice its greatest width. Scape, with head in dorsal view, bearing abundant subdecumbent short hairs, some hairs slightly longer but never longer than half the maximum scape width. Mandible elongate with external and basal margins mostly parallel to each other, basal margin broadly convex, basal angle blunt and obtuse; masticatory margin weakly concave, edentate; mandibular surface smooth with scattered punctae. Palp formula: 4,3.

Dorsal promesonotal margin forms single convexity in lateral view of mesosoma, punctuated by promesonotal articulation, and separated from very broadly convex dorsal propodeal margin by well-impressed metanotal groove. Dorsal propodeal margin in lateral view curves onto jagged declivitous margin; propodeal tooth blunt and low, poorly developed. Mesosternum with anteromedian, longitudinal keel-like process that extends posterad to same distance as metanotal groove; keel in lateral view mostly convex with small but distinct posterior pointing denticle just anterad of posterior end of keel. Promesonotum and dorsum of propodeum mostly smooth and shining with sparse punctulae. Propleuron mostly smooth and shining. Mesopleuron with slightly irregular transverse striae in anterolateral area of anepisternum and along posteroventral area of katepisternum. Metapleuron and propodeal side mostly smooth and shining, with rugulae posteroventrad. Declivity with 5–6 transverse rugae. Mesonotum subrectangular in dorsal view, width 0.61–0.71 its length, promesonotal articulation anteriorly convex, metanotal groove straight and smooth. Mesometapleural suture well-impressed, scrobiculate; metapleuro-propodeal suture indistinct; propodeal declivity transversely striate. Metathoracic spiracle with small bulla; propodeal spiracle oval, posterolaterally directed. Anteroventral mesopleural carina distinct and gradually widening anterad, ending as blunt angle close to mid-length of anepisternum.

Petiolar node subtriangular in lateral view, highest posterad, anterior and dorsal margins joined into single convex curve, posterior margin vertical, mostly straight to very weakly convex, apex bluntly curved; subpetiolar process small and hook-like. Node elongate in dorsal view with slightly convex anterior margin, straight lateral margin, and straight to weakly convex posterior margin; width of anterior margin less than half that of posterior margin; imaginary transverse section at node mid-length would have straight, V-shaped sides. Node and gaster mostly smooth and shining with sparse punctulae. Procoxa mostly smooth and shining; apex of meso- and metatibia with or without small apical extern—a seta, apex of protibia without setae. Body in general with abundant, erect to subdecumbent golden hairs of various lengths. Head capsule, most of mesosoma, petiole, and most of anterior gastral segments black; scape, posterior metapleuron, and coxae dark ferruginous brown; funiculus, mandible, tibiae, tarsi, and most of gastral apex brown to ferruginous brown.

Gyne and male. Unknown.

Etymology. The species name is a nominative feminine singular of the Latin *academicus*, which refers to an

academic or academician. This name was chosen in recognition of the type locality being within the *Campus Politécnico* of the Federal University of Paraná.

Discussion. *Leptogenys academica* fits into the *crudelis* group of species (Lattke 2011) with the exception of having a scrobiculate metanotal sulcus. This fair-sized species will key without difficulties to couplet 37 in Lattke (2011), whereupon the reader may use the modification to the key provided below. The anteromedial eye margin of all the studied specimens of *L. academica* have the ommatidia along rows 1–3 black, contrasting with grey-silver color of the rest of the eye, giving it a more elongate appearance upon first glance. This feature was not considered in the description as it could be an artifact.

This species was found during a series of pitfall sampling campaigns in a patch of forest next to the Zoology Department on the Campus Politécnico of the Universidade Federal do Paraná, within the metropolitan area of the city of Curitiba. The vegetation in the reserve is mostly secondary forest with emergent *Araucaria angustifolia* (Bertol.) Kuntze within a humid subtropical mesothermic climate, or Cfb according to the Köppen classification scheme (Reginato *et al.* 2008). The discovery of these ants underline how little we know about the ant diversity in the Atlantic Forests of Brazil despite their relatively long history of ant collecting, and their proximity to large urban centers such as São Paulo, Rio de Janeiro, and Curitiba. In the case of *L. academica*, the type series was collected in the landscape immediately surrounding one of the largest entomological collections in the country and home to Brazil's oldest entomology graduate school. The fact that the specimens representing both species are the product of sampling using pitfall traps proves the usefulness of this technique for collecting these mostly nocturnal predatory ants.

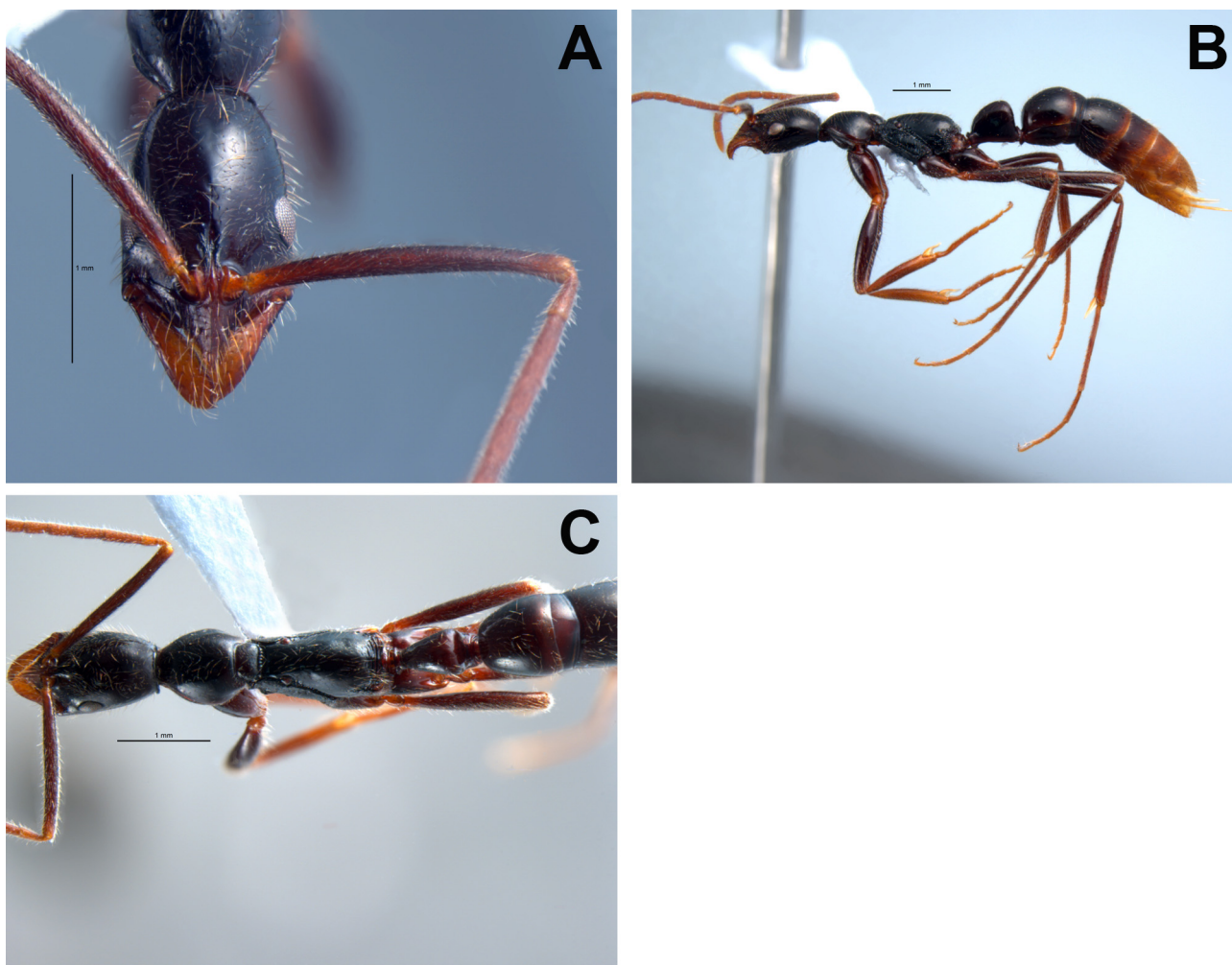


FIGURE 1. *Leptogenys academica* sp. nov. Holotype. A: Head, dorsal view. B: Body, lateral view. C: Body, dorsal view. All scale bars = 1 mm.

***Leptogenys carioca* n. sp.**

urn:lsid:zoobank.org:act:54215E50-5245-4BBC-A56D-0B1EBE2F349B

Fig. 2

Worker diagnosis. Apex of median clypeal lobe blunt, not acutely pointed; pronotal dorsum mostly smooth and shining with sparse punctae and undulations, mesonotum mostly smooth with abundant punctae, mesopleuron with abundant transverse rugulae which grade into striae, anterior propodeal dorsum and metanotum transversely rugulose—punctate, posterior propodeal dorsum mostly smooth and shining with sparse punctae.

Examined material. Holotype: Brazil, Rio de Janeiro, P. N. Itatiaia, 1991m, 22°24'41.90"S, 44°38'18.84"W, 20.I.2015, Lasmar *et al.* col. Projeto Gradiente Altitudinal. Mata Atlântica—Transecto 6A, Pitfall Epigéico Ponto: 4B. Deposited in DZUP with unique specimen identifier DZUP 548779. Paratype: Brazil, Rio de Janeiro, P. N. Itatiaia, 2000m, 22°24'37.43"S, 44°38'17.10"W, 20.I.2015, Lasmar *et al.* col. Projeto Gradiente Altitudinal. Campo de Latitude—Transecto 6B, Pitfall Epigéico Ponto: 4A. One point-mounted worker deposited in MZSP with unique specimen identifier DZUP 548780.

Worker dimensions, Holotype (Paratype): HL 1.88 (1.80); HW 1.06 (1.00); ML 0.84 (0.78); EL 0.38 (0.38); SL 2.00 (1.97); PW 1.00 (0.97); WL 2.94 (2.91); PH 1.00 (1.00); PL 1.14 (1.13); DPW 0.63 (0.59) mm. CI 0.57 (0.56); MI 0.79 (0.78); OI 0.35 (0.38); SI 1.88 (1.97); LPI 0.88 (0.89); DPI 0.55 (0.53).

Worker. Head elongate, rhomboid-like in full-face view, slightly wider anterad than posterad, posterior margin (defined by occipital carina) weakly concave to straight, lateral margin slightly convex, occipital carina well-defined; frontal carina extends posterad close to but not reaching ocular mid-length, median clypeal process strongly triangular, narrowing towards blunt apex. Eye prominent, convex, occupying close to one-quarter of lateral cephalic margin in cephalic full-face view. Cephalic dorsum smooth and shining with scattered piligerous punctae, clypeus with longitudinal striae that partially extend onto median process; cephalic ventral surface smooth and shining with scattered piligerous punctae. Scape smooth and shining, with abundant suberect hairs, longest hairs not longer than maximum scape width; scape extends beyond posterior cephalic margin by almost half its length; length of pedicel 2/3 that of third antennomere, and subequal to fourth antennomere length; length of third antennomere over 3x longer than its apical width; funicular segments cylindrical and densely covered with suberect hairs. Mandible elongate and subparallel, basal margin slightly convex, masticatory margin weakly concave and edentate, mandibular surface mostly smooth with scattered punctae and short rugulae basally; masticatory margin forms obtuse angle with basal margin. Palpal formula:4, 3.

Mesosoma with well-marked metanotal groove in lateral view that separates broadly convex promesotonal margin from mostly straight to slightly undulating dorsal propodeal margin, propodeal dorsum curves continuously to declivitous margin; declivitous margin weakly jagged; propodeum armed with low, broadly triangular teeth. Pronotum mostly smooth and shining with scattered punctae dorsally and scattered punctulae laterally, propleuron mostly smooth; mesonotum smooth with sparse punctae; propodeal dorsum mostly smooth, anteriorly with strip of transverse striae. Mesopleuron with transverse rugulae interspersed with colliculate areas; lateral surface of metapleuron and propodeum mostly smooth with scattered undulations and rugulae mostly concentrated posterad around metapleural gland and base of propodeal tooth. Propodeal declivity with transverse coarse striae.

Mesosternum in lateral view with anteromedian, longitudinal keel-like process that extends posterad to same distance as metanotal groove; keel with small, but distinct, posteriorly pointing denticle just anterad of posterior end of keel. Mesonotum in dorsal view rectangular, width 0.71–0.72 its length. Mesometapleural suture well-impressed, scrobiculate; metapleuro-propodeal suture weakly defined as strip of short oblique parallel striae; anteroventral mesopleural carina well-developed, slightly expanded anterad; propodeal spiracle elongate, facing posterolaterally. Petiolar node in lateral view elongate and triangular, anterodorsal margin forms continuous convexity, highest point blunt, posterior margin mostly vertical, weakly convex. Anterior node margin width in dorsal view less than half that of posterior margin, lateral margin straight to weakly concave, posterior margin convex. Node smooth and shining with scattered short hairs, posterior face not sharply separated from lateral face. Gaster smooth and shining with scattered short, suberect hairs. Procoxa mostly smooth and shining in lateral view. Mesosoma with scattered to suberect and erect hairs; suberect to erect hairs present throughout head, coxa with decumbent hairs; mesotibia and metatibia with conspicuous pubescence. Protibial apex lacking apical seta, mesotibial external apex with single seta; metatibial external apex with 0/1 seta. Head, mesosoma, node, and most of gaster black; antenna, mandible, clypeus, legs, and apex of gaster brown.

Gyne and male. Unknown.

Etymology. The species name is derived from the Brazilian Portuguese noun for a person or thing originally from the state of Rio de Janeiro.

Discussion. Workers of *L. carioca* will key without ambiguity to couplet 30 in Lattke 2011, but then may cause some confusion as the propodeal dorsum does present some degree of punctures and rugulae. Nevertheless there are large areas of smooth and shining cuticle, enough that the irregular sculpturing does not dominate the dorsal propodeal surface, and thus it could be keyed to couplet 34, eventually arriving at couplet 37. A modification of the key in Lattke (2011) is provided below for identifying both *L. carioca* and *L. academica*. Besides the characters used in the key for separating these two new species the following morphological differences may also be observed. The pronotal dorsal margin in lateral view is evenly and broadly convex in *L. carioca* while in *L. academica* there is a distinct anterior margin separated by a blunt obtuse angle from the mostly horizontal dorsal margin. The metapleuro-propodeal suture in *L. carioca* is visible as a strip of shallow and short oblique parallel striae but this suture is not discernible in *L. academica*.

Itatiaia National Park protects part of the Itatiaia Plateau in the southern Mantiqueira mountains. The altitudes range from 1000 to 2000 m and most of the forests are classified as either *Floresta Ombrófila Densa Alto-montana* or *Floresta Ombrófila Mista Alto-montana* (IBGE, 2012) both with a canopy averaging 20 m high and belonging to an altitudinal subtropical climate (Cwb) in the Koeppen scheme. Temperatures during the year may vary from 3°C to 30°C, with occasional freezes some eight or so days in a year (Meireles *et al.* 2014). Known from only two workers, we can only surmise that the species prefers the cooler elevations of the southern Atlantic Forest, ranging close to 2000 meters above sea level. This contrasts with the preference for lowland habitats that is more widespread for the genus (Lattke 2011) and is of interest given the possible negative impact of climate change on mountain inhabiting biota, particularly in the tropics (Lemes *et al.* 2014).

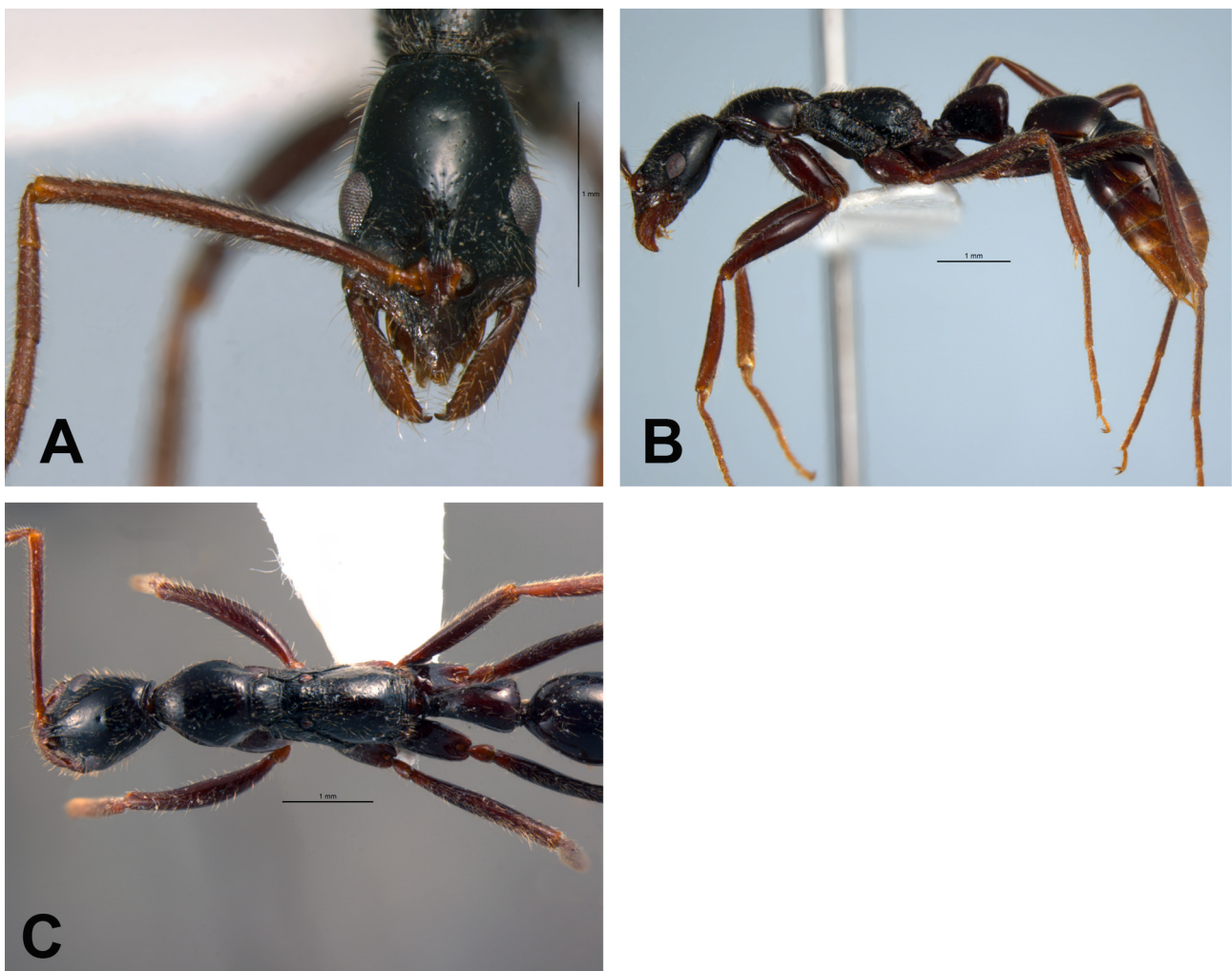


FIGURE 2. *Leptogenys carioca* sp. nov. Holotype. A: Head, dorsal view. B: Body, lateral view. C: Body, dorsal view. All scale bars = 1 mm.

Identification

The above new species are included in the following modification to the key for identification of the New World species of *Leptogenys* in Lattke (2011).

37. Propodeal declivity in lateral view ending in an abrupt overhang formed by propodeal lobes (Fig. 40B); mandible expanding apicad of mid-length; body with blue iridescence (southeastern Brazil) *luederwaldti*
- Propodeal lobes in lateral view absent or low and weakly developed (Fig. 71B), shaped either rounded or bluntly triangular, never forming an overhang; mandible not expanding apicad of mid-length; body lacking any iridescence 38
38. Petiolar node in lateral view shaped as elongate triangle, with brief vertical anterior margin; masticatory margin of mandible meeting internal angle at an abrupt, almost perpendicular angle; foretibial apex with a transparent cuticular lobe next to strigil (Panama—eastern Peru) *cuneata*
- Petiolar node in lateral view not elongate, anterior and dorsal margins form a continuous convexity; masticatory and internal mandibular margins meeting through blunt angle or convexity; foretibial apex without a transparent cuticular lobe next to strigil 38a
- 38a. Head subquadrate (CI 0.76–0.78), median clypeal process shaped as short rounded lobe with 3–4 seta on apex; mandible widest at mid length; propodeum rounded and unarmed (eastern Peru) *peruana*
- Head in dorsal view elongate (CI 0.56–0.61), median clypeal process triangular, evenly tapering anterad, apex lacking setae; mandible in dorsal view of uniform width; propodeal declivity with low, but distinct, lateral lobes or teeth (se Brazil) 38b
- 38b. Size larger (WL 2.91–2.94 mm); propodeal dorsum smooth and shining with sparse piligerous punctulae; propodeal lobe in lateral view triangular with jagged dorsal margin. *academica* n. sp.
- Size smaller (WL 2.47–2.72 mm); propodeal dorsum mostly smooth and shining with scattered patches of shallow transverse rugulae and scattered shallow punctae; propodeal lobe shaped as low rounded lobe without jagged margins *carioca* n. sp.

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References

- Arimoto, K. (2017) Taxonomy of the *Leptogenys modiglianii* species group from southeast Asia (Hymenoptera, Formicidae, Ponerinae). *ZooKeys*, 651, 79–106.
<https://doi.org/10.3897/zookeys.651.10336>
- Bharti, H. & Wachkoo, A.A. (2013) Two new species of the ant genus *Leptogenys* (Hymenoptera: Formicidae) from India, with description of a plesiomorphic ergatogyne. *Asian Myrmecology*, 5, 11–19.
- Bolton, B. (2018) An online catalog of the ants of the world. Available from: <http://antcat.org/catalog/430087> (accessed 18 January 2018)
- IBGE. (2012) Manual técnico da vegetação brasileira. Instituto Brasileiro de Geografia e Estatística. Rio de Janeiro, 271 pp. Available from: <https://biblioteca.ibge.gov.br/visualizacao/livros/liv63011.pdf> (accessed 20 January 2018)
- Lattke, J.E. (2011) Revision of the New World species of the genus *Leptogenys* Roger (Insecta: Hymenoptera: Formicidae: Ponerinae). *Arthropod Systematics & Phylogeny*, 69 (3), 127–264.
- Lemes, P., Melo, A.S. & Loyola, R.D. (2014) Climate change threatens protected areas of the Atlantic Forest. *Biodiversity and Conservation*, 23, 35–368.
<https://doi.org/10.1007/s10531-013-0605-2>
- Meireles, L.D., Kinoshita, L.S. & Shepherd, G.J. (2014) Composição florística da vegetação altimontana do distrito de Monte Verde (Camanducaia, MG), Serra da Mantiqueira Meridional, Sudeste do Brasil. *Rodriguésia*, 65, 831–859.
<https://doi.org/10.1590/2175-7860201465403>
- Rakotonirina, J. C. & Fisher, B. L. (2014) Revision of the Malagasy ponerine ants of the genus *Leptogenys* Roger (Hymenoptera: Formicidae). *Zootaxa*, 3836 (1), 1–163.
<http://www.mapress.com/zootaxa/2014/f/zt03836p163.pdf>
- Reginato, M., Matos, F.B., da Silveira Lindoso, G., de Souza, C.M.F., Prevedello, J.A., Morais, J.W. & Evangelista, P.H.L. (2008) A vegetação na Reserva Mata Viva, Curitiba, Paraná, Brasil. *Acta Biológica Paranaense*, 37, 229–252.
<https://doi.org/10.5380/abpr.v37i0.13211>
- Schmidt, C.A. & Shattuck, S.O. (2014) The higher classification of the ant subfamily Ponerinae (Hymenoptera: Formicidae), with a review of ponerine ecology and behavior. *Zootaxa*, 3817 (1), 1–242.

<http://dx.doi.org/10.11646/zootaxa.3817.1.1>

Sharaf, M.R., Akbar, S.A., Al Dhafer, H.M. & Aldawood, S.A. (2017) A new ant species of the *Leptogenys sulcinoda*-group (Hymenoptera: Formicidae) from Saudi Arabia. *Zoology in the Middle East*, 7140, 1–8.

<https://doi.org/10.1080/09397140.2017.1292645>

Xu, Z.-H. & He, Q.-J. (2015) Taxonomic review of the ponerine ant genus *Leptogenys* Roger, 1861 (Hymenoptera: Formicidae) with a key to the Oriental species. *Myrmecological News*, 21, 137–161.