

## Additions to the taxonomy of *Pheidole* (Hymenoptera: Formicidae) from the southern grasslands of Brazil

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### ABSTRACT

The ant genus *Pheidole* is the most species-rich lineage of ants in the world and one of the dominant organisms in tropical regions. However, the knowledge of *Pheidole* diversity in the southern half of the Neotropical Region is fragmentary. Here, we offer contributions to the *Pheidole* taxonomy considering the species that occur in the grassland formations of South Brazil. The following species are revived from synonymy: *P. idiota* Santschi **rev. stat.**, *P. obscurior* Forel **rev. stat.**, *P. paranana* Santschi **stat. rev. et n. stat.** and *P. strobili* Emery **rev. stat.** The following synonyms are proposed: *P. idiota* (= *P. laticornis* Wilson **n. syn.**), *P. obscurior* (= *P. partita* Mayr **n. syn.**, = *P. incisa evoluta* Borgmeier **n. syn.**) and *P. strobili* (= *P. rufipilis divexa* Forel **n. syn.**, = *P. nitidula daguerrei* Santschi **n. syn.**, = *P. perversa* Forel **n. syn.**, = *P. perversa richteri* Forel **n. syn.**, = *P. strobili misera* Santschi **n. syn.**). Finally, six new species are described: *P. abakytan* **n. sp.**, *P. abaticanga* **n. sp.**, *P. cangussu* **n. sp.**, *P. curupira* **n. sp.**, *P. mapinguari* **n. sp.**, and *P. obapara* **n. sp.**

### Introduction

Among ant genera, *Pheidole* Westwood is the most species-rich with 1,151 species and 129 subspecies currently described (Bolton, 2020) and likely contains well over 1,500 species. *Pheidole* is a cosmopolitan genus, first diversifying in the New World approximately 29 Mya, with diversification in the Old World beginning around 11 Mya (Economo et al., 2019). More than 700 described *Pheidole* species inhabit the New World, with nearly 620 species recorded from the Neotropical Region and around 150 recognized in Brazil (AntWeb.org). Thanks to Wilson's (2003) monograph, considered the most important single taxonomic contribution to the genus thus far, and the works by Longino (2009, 2019), our knowledge on diversity and taxonomy of *Pheidole* has increased significantly for the New World. However, as expected for such a hyperdiverse genus, recent works did not cover all the diversity for the genus and had particularly sparse coverage in some areas of the Neotropics. Among these, the *Pheidole* fauna of the southern half of South America is far from thoroughly documented.

Due to this knowledge deficit, it is expected that the biomes of Brazil harbor a high number of undescribed *Pheidole* species. Among Brazilian

phytophysiognomies, the non-forest ecosystems (e.g. grasslands, savannas, shrublands, and open woodlands) are widespread. These ecosystems cover large portions of four different biomes (i.e. *Caatinga*, *Cerrado*, *Pampa*, and *Pantanal*) and occur to a lesser extent in other two forest biomes (i.e. Amazon Forest and Atlantic Rainforest) (Overbeck et al., 2015). In South Brazil, which encompasses the states of Rio Grande do Sul, Santa Catarina, and Paraná, the non-forest ecosystems are known as *Campos Sulinos*, and are naturally widespread over two different biomes, the *Pampa* in the southernmost region (Overbeck et al., 2007) and patches of grasslands within the Atlantic Forest in the northern portions (Andrade et al., 2016).

Grassland physiognomy in this region is not homogeneous and can vary strongly regarding vegetation coverage, elevation, and the anthropic influence (Overbeck et al., 2007). *Campos Sulinos* can be composed of noticeably short vegetation, mainly formed by grasses, to tall and complex vegetation composed by shrub and treelet species (Overbeck et al., 2007). The southern part of the grasslands in Brazil encompasses the *Pampa* biome, an open ecosystem with an average elevation of 800 m a.s.l., exclusive for the state of Rio Grande do Sul in Brazil and also distributed in Argentina and Uruguay. This is considered one of the most species-rich grasslands in the world, despite being

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more intensively grazed when compared to the highland grasslands of Santa Catarina and Paraná that are included in the Atlantic Forest biome (Overbeck et al., 2007; Dröse et al., 2017). The highland grasslands in the Atlantic Forest biome are mainly distributed from about 800 to 1,000 m a.s.l., with highest peaks up to 1,800 m, eventually forming mosaics with *Araucaria* forests (Andrade et al., 2016).

In the Paraná state, the non-forested ecosystems, commonly referred as *Campos Gerais* (Franco & Feitosa 2018), are characterized by the combination of savannas (*Cerrado*), in the northern portion, and open grasslands permeated by gallery forests with *Araucaria angustifolia* (Bertol.) Kuntze covering rocky soil with canyons, caves, and shallow rivers (Maack, 1981; Melo et al., 2001). Additionally, these highland grasslands are adapted to frequent burnings concentrated at the end of the winter, resulting in a dominance of highly fire-resilient grass tussock species (Boldrini, 2009).

In the recent years, ant surveys have been conducted in the Brazilian southern grasslands in Paraná (e.g. Franco & Feitosa 2018; Martins et al., 2020), Santa Catarina (e.g. Martins et al., 2020), and Rio Grande do Sul (e.g. Diehl et al., 2005; Albuquerque & Diehl, 2009; Pinheiro et al., 2010; Rosado et al., 2012; Diehl et al., 2014; Dröse et al., 2017), all of them revealing a considerable number of unidentified *Pheidole* species. Several limitations have led to this taxonomic impediment, including: (1) the absence of a comprehensive and user-friendly key to the identification of the Brazilian *Pheidole* species, (2) the difficulty in understanding the species limits within the genus, (3) and the high number of undescribed species from the southern part of the Neotropics.

Besides the species described by Longino (2009, 2019) from the Mesamerican fauna, a single *Pheidole* species was recently described from Bahia in Brazil (*Pheidole protaxi* Oliveira, et al., 2015). Thus, considering the scarcity of taxonomic studies on *Pheidole* in the southernmost areas of the Neotropical Region, and the accumulation of specimens from recent surveys, here we offer additions to the taxonomy of *Pheidole* known from natural grasslands of South Brazil. To visually improve the taxonomic descriptions, we provide images, 3D models, and 3D videos based on surface volume renderings of microtomography (micro-CT) scans for all new species. A synopsis of the species recognized for these environments is also provided, as well as updated taxonomic keys based on Wilson's (2003) monography. This is the first study focusing on the *Pheidole* species from a single ecosystem in Brazil.

## Methods

### *Specimen examination and imaging*

The specimens examined here were obtained from different published and ongoing surveys carried out in the natural grasslands of South Brazil (Dröse et al., 2017; Franco & Feitosa 2018; Dröse et al., 2019; Martins et al., 2020) and sent for identification and/or deposit in the *Coleção Entomológica Padre Jesus Santiago Moure* of the *Universidade Federal do Paraná* (DZUP). Also, to improve our species delimitation hypotheses and examine type-specimens, we have visited some of the most representative ant collections for *Pheidole* in the New World, including the *Museu de Zoologia da Universidade de São Paulo*, the myrmecological collection of the *Centro de Pesquisas do Cacau* in Bahia, and the Museum of Comparative Zoology of the Harvard University, Cambridge. In total, approximately 1,550 specimens were examined.

A considerable part of the material examined here derives mainly from three large projects carried out in South Brazil, of which voucher specimens were deposited in DZUP. The first project, coordinated by RMF at the *Laboratório de Sistemática e Biologia de Formigas* (UFPR), aimed a comprehensive survey of the ant fauna inhabiting the natural savannas and grasslands of the state of Paraná. In this project, ants were

collected using pitfall traps and Winkler extractors in four different reserves of the state, representing the first standardized inventory of ants in the natural grasslands of Paraná (for further details see Franco & Feitosa (2018)).

The second project, namely SiSBiota, was conducted by *Embrapa Floresta* (Colombo, Paraná, Brazil) and the *Universidade Estadual de Santa Catarina* (UDESC). This project focused on verifying the effect of different land use systems on the composition of epigeaic and hypogaic invertebrates. Samplings encompassed several vegetational formations, including natural and anthropic grasslands (Martins et al., 2020). In total, ants were collected in seven municipalities with representative areas of grasslands, one in the Paraná state, and six in the Santa Catarina state.

The last project, developed by the research group of the *Laboratório de Ecologia de Interações* of *Universidade Federal do Rio Grande do Sul* (UFRGS), investigated how ant communities are locally assembled in natural forest-grassland ecotones distributed over the south Brazilian region (Dröse et al., 2017, 2019). In this project, a total of six natural grassland areas under traditional cattle grazing in the state of Rio Grande do Sul were sampled.

Examinations were made at 80x magnification with a Zeiss SteREO DiscoveryV8 dissecting microscope. High-resolution images were obtained with an Axiocam 305 color coupled in Zeiss SteREO Discovery. V20, extended depth focus was made in the software Zen Blue v.2.6, and subsequently treated to correct for brightness and contrast.

### *X-ray micro-computed tomography and 3D images*

The use of Micro-CT in systematic and taxonomic research is becoming more common. Recent studies have demonstrated its utility for generating high-resolution, virtual, and interactive three-dimensional reconstructions of whole ant specimens (e.g. Fischer et al., 2016; Sarnat et al., 2016; Hita Garcia et al., 2017). One of the main advantages of the approach is the generation of an openly available cybertype dataset to accompany the physical type, thus protecting the original exemplar from deterioration (Faulwetter et al., 2013; Hita Garcia et al., 2017). Here, micro-CT/ $\mu$ CT scans were created with a ZEISS Xradia 510 Versa and the ZEISS Scout and Scan Control System software. Scan settings were selected according to yield optimum scan quality: 4x objective, exposure times between 0.6 and 3 seconds, source filter "Air", voltage between 40 and 50 kV, power between 3 and 4W, and field mode "normal" (Table 1). The combination of voltage, power and exposure time was set to yield intensity levels of between 15,000 and 17,000 across the whole specimen. Scan times varied from 27 to 50 minutes, depending on exposure times. Full 360-degree rotations were done with a number of 801 projections. The resulting scans have resolutions of 1013x992x999 (HxWxD) pixels and voxel sizes range between 2.25  $\mu$ m and 5.39  $\mu$ m. 3D reconstruction of the resulting scans was done with XMReconstructor and saved in DICOM file format.

The 3D surface models were generated with InVesalius (2016) v3.1.1 software (de Moraes et al., 2011), an open-source software for 3D reconstruction developed by *Centro de Tecnologia da Informação Renato Archer* - CTI and available online. All models were posteriorly simplified, corrected, and filmed using MeshLab v.2016 (Cignoni et al., 2008) and Blender v2.80 (Blender, 2019).

### *Taxonomic procedures*

Taxonomic units (morphospecies) were delimited using characters of external morphology such as body shape, surface sculpturing, and pilosity. The delimited morphospecies were compared with the type material of valid species and junior synonyms to confirm their identities. All morphospecies not corresponding to available names were described

**Table 1**

Overview of micro-CT scanning data presenting specimen data, scan settings, and voxel sizes for the resulting scans (all specimens are workers and all files are in DICOM format).

Species	Identifier	Sub-caste	Type Status	Magnification (x)	Exposure (s)	Voxel size (µm)	Voltage (kV)	Power (W)	Amperage (µA)
<i>abakytan</i>	CASENT0742943	major	Holotype	4	0.7	3.8151	50	4	80
<i>abakytan</i>	CASENT0742944	minor	Paratype	4	0.6	3.2144	50	4	79
<i>abaticanga</i>	CASENT0790160	major	Holotype	4	1.5	2.8127	40	3	75
<i>abaticanga</i>	CASENT0790161	minor	Paratype	4	1	2.2503	50	4	80
<i>cangussu</i>	CASENT0742941	major	Holotype	4	3	5.3997	50	4	80
<i>cangussu</i>	CASENT0742942	minor	Paratype	4	0.6	3.0684	50	4	80
<i>curupira</i>	CASENT0742949	major	Holotype	4	2	5.0622	50	4	79
<i>curupira</i>	CASENT0742950	minor	Paratype	4	1	3.3751	40	3	75
<i>mappinguari</i>	CASENT0742947	major	Holotype	4	1	4.8208	50	4	80
<i>mappinguari</i>	CASENT0742947	minor	Paratype	4	0.9	3.3751	40	3	75
<i>obapara</i>	CASENT0790158	major	Holotype	4	1.2	3.0684	40	3	74
<i>obapara</i>	CASENT0790159	minor	Paratype	4	1.1	2.411	50	4	79

as new, and for those that have been recognized among synonyms, the name status was revived. The revived species were redescribed so that the important features for each one could be updated and standardized. LucidBuilder software (LucidTeam) was used to generate a list of characters, which served as the basis for the descriptions in a semiautomatic method.

The taxonomic synopsis of the *Pheidole* species in Brazilian southern grasslands includes new species and species with revived status, and also the previously published records for this region (Diehl et al., 2005; Pinheiro et al., 2010; Rosado et al., 2012; Dröse et al., 2017; Franco & Feitosa, 2018; Dröse et al., 2019; Martins et al., 2020; see Figs. 13–18).

Considering the noteworthy diversity of *Pheidole* and the limitations of making available an identification key that included only the species of this study, we included the species treated here in the last couplet required to access them in the keys provided by Wilson (2003).

#### Measurements and index abbreviations

Measurements were adapted from Sarnat et al. (2016) and Longino (2019) and were taken from at least one specimen of each worker subcaste. Specimens were measured with a dual-axis micrometer stage with output in increments of 0.001 mm. All measurements are presented in mm.

**EL** *Eye length*. Maximum eye length in lateral view.

**FL** *Metafemur length*. Length of metafemur measured along its long axis.

**HL** *Head length*. Maximum distance from the midpoint of the anterior clypeal margin to the midpoint of the posterior margin of the head, measured in full-face view. In majors, measured from midpoint of tangent between the anterior-most position of clypeus to midpoint of tangent between the posterior-most projection of posterolateral lobes.

**HW** *Head width*. Maximum width of the head in full-face view, excluding the eyes.

**ML** *Mesosomal length*. Maximum length of mesosoma measured in lateral view as the diagonal length of the mesosoma from the point at which the pronotum meets the cervical shield to the apex of the propodeal lobe.

**PeW** *Petiole width*. Maximum width of the petiole measured in dorsal view.

**PeL** *Petiole length*. Maximum length of petiole measured from anteroventral junction with propodeum to posterodorsal junction with postpetiole.

**PpW** *Postpetiole width*. Maximum width of the postpetiole measured in dorsal view.

**SL** *Scape length*. Length of the antennal scape, including the lamella encircling the base of the scape but excluding the basal condyle.

**IHP** *Inner hypostomal projection*. Distance measured between the inner hypostomal projection in ventral view considering the approximate midpoint of the base of the projection. Apply to major workers and queens.

**OHP** *Outer hypostomal projection*. Distance measured between the outer hypostomal projection in ventral view considering the approximate midpoint of the base of the projection. Apply to major workers and queens.

**CI** *Cephalic index*.  $HW/HL \times 100$ .

**SI** *Scape index*.  $SL/HW \times 100$ .

**HPI** *Hypostomal projections index*.  $IHT/OHT \times 100$ .

#### Terminology

The terminology follows Wilson (2003) and Longino (2019) for the morphological structures, Wilson (1955) for pilosity, and Wilson (2003) and Longino (2019) for surface sculpturing. Regarding the latter, a common sculpture pattern in *Pheidole* is the areolate one. In some cases, it can be superficially marked and hardly recognized; however, it can be seen by using indirect light. Major and minor workers are referred as ♂ and ♀ in the examined material, respectively.

#### Repositories

Collections are referred to by the following acronyms, which follow the Insect and Spider Collections of the World website (<http://hbs.bishopmuseum.org/codens/>):

DZUP Coleção Entomológica Padre Jesus Santiago Moure of the Universidade Federal do Paraná, Curitiba, Brazil.

MCZC Museum of Comparative Zoology, Cambridge, MA, USA.

MHNG Muséum d'Histoire Naturelle, Geneva, Switzerland.

MSNG Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy.

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

NHMB Naturhistorisches Museum, Basel, Switzerland.

NHMW Naturhistorisches Museum Wien, Wien, Austria.

#### Data availability

All the type specimens examined in this study have been databased and the data is freely accessible on AntWeb (<http://www.antweb.org/>;

AntWeb, 2020). Each specimen can be traced by a unique specimen identifier attached to its pin (e.g. CASENTO764125). The Cybertype datasets provided in this study consist of the full micro-CT original volumetric datasets, 3D model in PLY and STL formats, and 3D rotation video files. All data are freely available in the supplementary material on <http://doi.org/10.6084/m9.figshare.9775895>.

### Taxonomic synopsis of the *Pheidole* species in Brazilian southern grasslands

#### *aberrans* group

- Pheidole aberrans* Mayr, 1868  
 = *Pheidole aberrans diversiceps* Santschi, 1916  
 = *Pheidole aberrans fartilia* Forel, 1913  
 = *Pheidole aberrans mutica* Emery, 1906  
*Pheidole cavifrons* Emery, 1906  
 = *Pheidole arciruga* Forel, 1908  
 = *Pheidole cavifrons fuscipunctis* Santschi, 1916

#### *diligens* group

- Pheidole abakytan* **new species**  
*Pheidole idiota* Santschi, 1923 **revived status**  
 = *Pheidole laticornis* Wilson, 2003 **new synonym**  
 = *Pheidole vafra idiota maculifrons* Santschi, 1929  
*Pheidole nubila* Emery, 1906  
*Pheidole oxyops* Forel, 1908  
 = *Pheidole genalis* Borgmeier, 1929  
 = *Pheidole oxyops regia* Forel, 1908  
*Pheidole paranana* Santschi, 1925 **revived status et new status**  
*Pheidole pubiventris* Mayr, 1887  
 = *Pheidole indistincta* Forel, 1899  
 = *Pheidole pubiventris cearensis* Forel, 1901  
 = *Pheidole pubiventris nevadensis* Forel, 1901  
 = *Pheidole pubiventris timmii* Forel, 1901  
 = *Pheidole variegata* Emery, 1896  
*Pheidole radoszkowskii* Mayr, 1884  
 = *Pheidole australis* Emery, 1890  
 = *Pheidole medialis* Wilson, 2003  
 = *Pheidole radoszkowskii acuta* Emery, 1894  
 = *Pheidole radoszkowskii luteola* Forel, 1893  
 = *Pheidole radoszkowskii opacissima* Forel, 1901  
 = *Pheidole radoszkowskii parvinoda* Forel, 1912  
*Pheidole triconstricta* Forel, 1886  
 = *Pheidole radoszkowskii discursans* Forel, 1912  
 = *Pheidole radoszkowskii saviozae* Forel, 1911  
 = *Pheidole triconstricta ambulans* Emery, 1906  
 = *Pheidole triconstricta hebe* Santschi, 1923  
 = *Pheidole triconstricta rosariensis* Forel, 1913  
*Pheidole vafra* Santschi, 1923

#### *fallax* group

- Pheidole acutidens* (Santschi, 1922)  
*Pheidole fallax* Mayr, 1870  
 = *Pheidole columbica* Forel, 1886  
 = *Pheidole fallax britoi* Forel, 1912  
 = *Pheidole fallax ovalis* Forel, 1912  
 = *Pheidole fallax rubens* Forel, 1899  
 = *Pheidole jelskii fallacior* Forel, 1901  
*Pheidole humeridens* Wilson, 2003  
*Pheidole jelskii* Mayr, 1884

- = *Pheidole fallax emiliae* Forel, 1901  
 = *Pheidole jelskii antillensis* Forel, 1901  
 = *Pheidole jelskii arenicola* Emery, 1894  
*Pheidole mapinguari* **new species**  
*Pheidole nitidula* Emery, 1888  
 = *Pheidole strobili silvicola* Borgmeier, 1927  
*Pheidole obscurior* Forel, 1886 **revived status**  
 = *Pheidole incisa evoluta* Borgmeier, 1929 **new synonym**  
 = *Pheidole partita* Mayr, 1887 **new synonym**  
*Pheidole obscurithorax* Naves, 1985  
*Pheidole pampana* Santschi, 1929  
*Pheidole strobili* Emery, 1906 **revived status**  
 = *Pheidole nitidula daguerrei* Santschi, 1931 **new synonym**  
 = *Pheidole perversa* Forel, 1908 **new synonym**  
 = *Pheidole perversa richteri* Forel, 1909 **new synonym**  
 = *Pheidole rufipilis divexa* Forel, 1908 **new synonym**  
 = *Pheidole strobili misera* Santschi, 1916 **new synonym**  
*Pheidole valens* Wilson, 2003

#### *flavens* group

- Pheidole abaticanga* **new species**  
*Pheidole breviseta* Santschi, 1919  
*Pheidole obtusopilosa* Mayr, 1887

#### *gertrudae* group

- Pheidole gertrudae* Forel, 1886  
 = *Pheidole gertrudae leonhardi* Forel, 1901  
 = *Pheidole gertrudae lorentensis* Santschi, 1933  
 = *Pheidole humilis* (Borgmeier, 1930)

#### *transversostrata* group

- Pheidole obapara* **new species**

#### *tristis* group

- Pheidole cangussu* **new species**  
*Pheidole curupira* **new species**  
*Pheidole fimbriata* Roger, 1863  
 = *Pheidole diversa* Smith, 1860  
 = *Pheidole fimbriata tucumana* Forel, 1913  
 = *Pheidole smithii* Dalla Torre, 1892  
 = *Pheidole soesilae* Makhan, 2007  
*Pheidole heyeri* Forel, 1899  
 = *Pheidole guilelmimuelleri ultrix* Forel, 1912  
*Pheidole rosae* Forel, 1901  
 = *Pheidole silvestrii* Emery, 1906  
*Pheidole spininodis* Mayr, 1887  
 = *Pheidole hohenlohei* Emery, 1888  
 = *Pheidole spielbergi* Emery, 1888  
 = *Pheidole spininodis bruta* Santschi, 1934  
 = *Pheidole spininodis lucifuga* Santschi, 1923  
 = *Pheidole spininodis pencosensis* Forel, 1914  
 = *Pheidole spininodis solaris* Santschi, 1929  
*Pheidole subarmata* Mayr, 1884  
 = *Pheidole cornutula* Emery, 1890  
 = *Pheidole cornutula dentimentum* Santschi, 1929  
 = *Pheidole cornutula imbecilis* Emery, 1906  
 = *Pheidole hondurensis* Mann, 1922  
 = *Pheidole subarmata borinquensis* Wheeler, 1908  
 = *Pheidole subarmata elongatula* Forel, 1893

- = *Pheidole subarmata nassavensis* Wheeler, 1905  
 = *Pheidole subarmata nefasta* Santschi, 1929

#### Additions to Wilson (2003) keys based on the nomenclatural acts of this study:

Key to the species in the *diligens* group

- 44** Major: all of dorsal surface of head capsule except vertexal area areolate and opaque; all of frontal lobes and region between them posterior to the frontal triangle covered by parallel longitudinal rugulae.....**44a**  
 – Major: at most only the anterior half of the dorsal head surface sculptured..... **44b**  
**44a** Major: pronotal dorsum areolate.....*Pheidole nubila*  
 – Major: pronotal dorsum reticulate-rugose .....  
 .....*Pheidole paranana* rev. stat. et n. stat.  
**44b** Major: a wide central space between frontal carinae smooth and shiny.....**45**  
 – Major: space between frontal carinae covered by parallel longitudinal rugulae.....*Pheidole abakytan* n. sp.
- 51** Major: longitudinal rugulae immediately mesad to eyes reaching halfway to vertexal margin, sides of mesonotum and propodeum with few rugulae.....**51a**  
 – Major: longitudinal rugulae immediately mesad to eyes reaching only one-fourth distance to vertexal margin, sides of mesonotum and propodeum lacking rugulae.....*Pheidole pampana*  
**51a** Major: clypeal disc with a median rugula .....  
 .....*Pheidole laevinota*  
 – Major: clypeal disc smooth.....*Pheidole strobili* rev. stat.
- 91** Major: dorsal surface of head and pronotum, in side view, covered by dense standing hairs.....**91a**  
 – Major: dorsal surface of head and pronotum, in side view, with sparse pilosity .....*Pheidole mooreorum*  
**91a** Major: antennal scape basally terete .....  
 .....*Pheidole idiota* rev. stat.  
 – Major: antennal scape basally thin.....*Pheidole vafra*

Key to the species in the *fallax* group

- 102** Major: dorsum and sides of propodeum lacking carinulae.....**102a**  
 – Major: dorsum and sides of propodeum covered by carinulae.....**103**  
**102a** Major: pronotum completely covered by transverse rugulae.....*Pheidole alienata*  
 – Major: only the anterior face of the pronotum with few transverse rugulae.....*Pheidole mapinguari* n. sp.  
**103** Major: the strip of head dorsum posterior to the frontal triangle lacking rugulae, smooth and shiny.....**103a**  
 – Major: the strip of head dorsum posterior to the frontal triangle covered by longitudinal rugulae all the way mesad to the midline of the head.....**104**  
**103a** Major: humerus, in dorsal-oblique view, subangulate .....  
 .....*Pheidole laevinota*  
 – Major: humerus, in dorsal-oblique view, rounded.....  
 .....*Pheidole strobili* rev. stat.

Key to the species in the *flavens* group

- 4** Major: in side view, space immediately laterad to eye reticulate-rugose. Minor: posterior half of head reticulate-rugose .....*Pheidole verrucula*  
 – Major: in side view, space immediately laterad to eye with any other combination of sculpture instead of reticulate-rugose. Minor: posterior half of head areolate, not reticulate-rugose.....**4a**  
**4a** Major: clypeal disc overlain with several rugulae.....  
 .....*Pheidole obtusopilosa*  
 – Major: clypeal disc smooth and shiny .....  
 .....*Pheidole abaticanga* n. sp.

Key to the species in the *transversostrata* group

- 3** Major: in side view, profile of head not “dented” by a strong concavity just anterior to the vertex, instead forming a smooth, continuous convexity.....*Pheidole transversostrata*  
 – Major: in side view, profile of head “dented” by a strong convexity just anterior to the vertex.....**3a**  
**3a** Major: space between eye and antennal fossa with longitudinal rugulae only .....**4**  
 – Major: space between eye and antennal fossa reticulate-rugose .....  
 .....*Pheidole obapara* n. sp.

Key to the species in the *tristis* group

- 16** Major: in side view, profile of mesonotal convexity triangular, with an acute apex.....**16a**  
 – Major: in side view, profile of mesonotal convexity surmounted by at most a low secondary convexity.....**17**  
**16a** Major: hypostomal margin with five teeth. Minor: seen from above and obliquely, propodeal projection reduced to an obtuse angle formed by the two propodeal face .....*Pheidole cornicula*  
 – Major: hypostomal margin with four teeth, without the median tooth. Minor: seen from above and obliquely, propodeal projection developed as a well-formed triangular projection.....  
 .....*Pheidole cangussu* n. sp.
- 74** Major: propodeal dorsum lacking rugulae, smooth to finely areolate.....*Pheidole manuana*  
 – Major: propodeal dorsum covered with transversal rugulae .....  
 .....**74a**  
**74a** Major: humerus overlain with few rugulae .....**75**  
 – Major: humerus smooth and shiny .....*Pheidole curupira* n. sp.

#### Species accounts

*Pheidole abakytan* n. sp.

urn:lsid:zoobank.org:act:8791EB98-2D7F-4ABD-808E-F069754CAC43  
 (Figs. 1, 11)

**Holotype major worker:** Brazil: PR, Jaguariaíva, Parque Estadual do Cerrado, 917m, 24°11'15.9"S 49°39'53.1"W, 15.i.2015 A. M. Oliveira, R. Feitosa, J. Maravalhas, H. Vasconcelos cols. [CASENT0742943] [DZUP]

**Paratype five major and seven minor workers:** same data as holotype [DZUP (2 ♂ and 2 ♀; DZUP549878, DZUP549879, DZUP549882, and CASENT0742944); MCZC (2 ♂ and 2 ♀; DZUP549875, DZUP549876, DZUP549880, and DZUP549881); MZSP (1 ♂ and 2 ♀; DZUP549877, DZUP549883, and DZUP549884)]

**Cybertypes:** holotype, major worker (CASENT0742943) (Supp 1 [online only]) and paratype, minor worker (CASENT0742944) (Supp 2 [online only]), with label transcribed above.

**Geographic range.** Brazil: Paraná.

**Measurements, major worker:** EL: 0.18; FL: 0.83 – 0.92; HL: 1.20 – 1.28; HW: 1.08 – 1.16; IHP: 0.38 – 0.40; ML: 1.10 – 1.20; OHP: 0.45 – 0.50; PeL: 0.38 – 0.43; PeW: 0.14 – 0.15; PpL: 0.18 – 0.20; PpW: 0.22 – 0.23; PSL: 0.08; SL: 0.85 – 0.92; CI: 90 – 91; SI: 76 – 81; HPI: 80 – 83 (n = 3).

**Major worker. Head:** head side, in dorsal view, broadly convex, with dense appressed setae; head dorsal profile forming a broadly, continuous convexity, and vertexal margin deeply emarginate. Hypostoma with median tooth vestigial; inner teeth distinct, narrow and slightly curved, converging apically, and widely spaced. Median clypeal carina absent; clypeal disc smooth. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, surpassing midheight between eye and vertexal margin but not reaching the margin, with a combination of appressed setae and standing. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally, and with a reticulate-rugose patch. Space between frontal carinae smooth with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface, in frontal view, smooth. **Mesosoma:** pronotum dorsally strongly areolate with a reticulate-rugose area anteriorly, and promesonotal dorsum, in lateral view, presenting two pairs of stiff standing setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum. **Metasoma:** petiolar peduncle, in profile, with dorsal margin narrowly concave, and petiolar node, in lateral view, broad and apically rounded. Postpetiole, in dorsal view, as wide as long and trapezoidal, and dorsally presenting stiff standing setae, two of them longer than the adjacent. First gastral tergum finely areolate; dorsally

with a combination of stiff standing and appressed setae, no more than 1.5× the eye length. Color reddish-brown.

**Measurements, minor worker:** EL: 0.13; FL: 0.65 – 0.73; HL: 0.63 – 0.70; HW: 0.50 – 0.60; ML: 0.80 – 0.93; PeL: 0.24 – 0.30; PeW: 0.10 – 0.13; PpL: 0.10 – 0.15; PpW: 0.14 – 0.18; PSL: 0.04 – 0.05; SL: 0.83 – 0.88; CI: 80 – 86; SI: 146 – 165 (n = 3).

**Minor worker. Head:** vertexal margin, in dorsal view, not emarginate and strongly rounded; occipital carina, in dorsal view, not visible; postgenal bridge, in lateral view, smooth. Anterior clypeal margin not emarginate; clypeal disc smooth. Space between eye and frontal carina strongly areolate, with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae finely areolate with a smooth median patch. Vertexal surface finely areolate. **Mesosoma:** pronotal surface strongly areolate, dorsally with a reticulate-rugose patch anteriorly, and promesonotal dorsum, in lateral view, presenting two pairs of stiff standing setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection triangular; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, with straight side, dorsally smooth, and presenting a combination of a pair of stiff standing setae, with shorter and appressed setae. First gastral tergum smooth; dorsally with a combination of stiff standing and appressed setae, no more than 1.5× the eye length. Color reddish-brown.

**Comments.** Similar species are *P. laevifrons* Mayr, *P. lemur* Forel, and *P. zelata* Wilson. All these species, which are included in the *diligens* group, present majors with lateral margins of the head with appressed setae, space between eye and frontal carina with a small reticulate-rugose patch, and vertexal surface smooth. *Pheidole abakytan* can be differentiated from *P. laevifrons* by first gastral tergum with a combination of stiff standing and appressed setae, while in *P. laevifrons* these setae are flexuous. *Pheidole lemur* has the first gastral tergum finely areolate, and *P. abakytan* has a smooth gastral surface. The main difference between *P. zelata* and *P. abakytan* is that the propodeal projection is spiniform in *P. zelata* while in *P. abakytan* this projection is triangular. Minors of *P. abakytan* have the head surface predominantly areolate, and in *P. laevifrons* and *P. zelata* the surface is smooth.

This species was collected in pitfall traps in a savanna area at 917 m. The type-locality, *Parque Estadual do Cerrado* in Jaguariaíva, Paraná state, represents the southernmost fragment of the Cerrado biome in Brazil, where the prevailing vegetation are the open woodlands.

**Etymology.** From Tupi-Guarani, Old Tupi, *ába* = hair, *akytan* of *akytã* = short (de Carvalho, 1987), in apposition, referring to the hairs on the head of the major worker. The Old Tupi (also known as *língua brasileira* “Brazilian language”) was the main language spoken by the ethnic groups that inhabited the Brazilian coast before the conquest by the Portuguese settlers. Vocabulary available on [http://www.oocities.org/indianlanguages\\_2000/](http://www.oocities.org/indianlanguages_2000/).

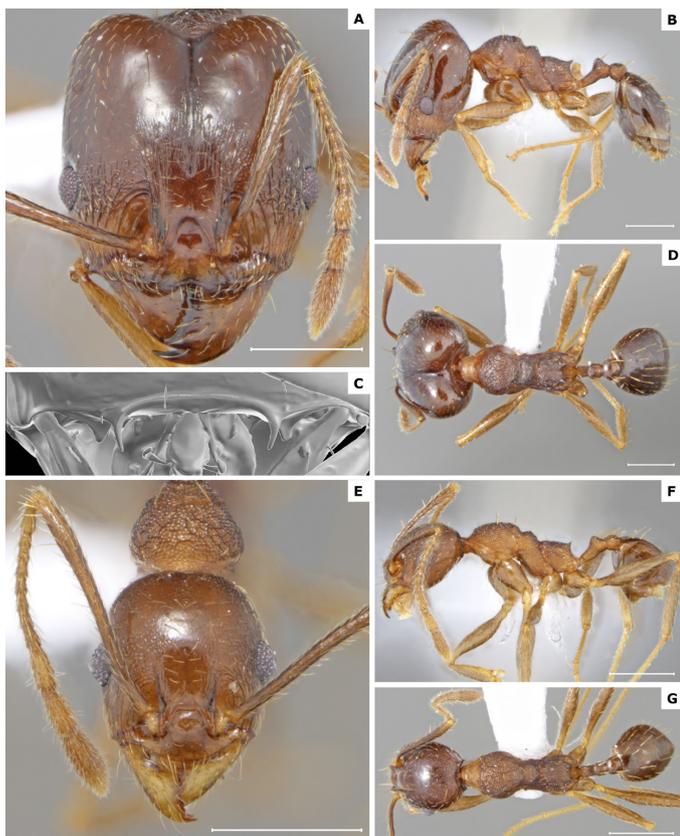
*Pheidole abaticanga* n. sp.

urn:lsid:zoobank.org:act:045B6A90-1854-40A0-AEFF-DE2FE3799B61 (Figs. 2, 11)

**Holotype major worker:** Brazil: PR, Tibagi, P.E. do Guartelá, 24°33'49.61"S 50°15'32.36"W, 20-25.ix.2015 W. Franco, R.M. Feitosa, A. Machado cols. [CASENT0790160] [DZUP]

**Paratype five major and three minor workers:** same data as holotype [DZUP] (1 ♂ and 1 ♀; DZUP549885 and CASENT0790161); MCZC (2 ♂ and 1 ♀; DZUP549888, DZUP549889, and DZUP549891); MZSP (2 ♂ and 1 ♀; DZUP549886, DZUP549887, and DZUP549890)

**Cybertypes:** holotype, major worker (CASENT0790160) (Supp 3 [online only]) and paratype, minor worker (CASENT0790161) (Supp 4 [online only]), with label transcribed above.



**Figure 1** *Pheidole abakytan* n. sp. Major worker, holotype, CASENT0742943: (A) full-face view (B) lateral view (C) hypostomal margin (D) dorsal view. Minor worker, paratype, CASENT0742944: (E) full-face view (F) profile view (G) dorsal view. Scale bar 0.5 mm. 3D model and rotation video (Supp 1 and 2 [online only]).

**Geographic range.** Brazil: Paraná.

**Measurements, major worker:** EL: 0.08 – 0.10; FL: 0.46 – 0.48; HL: 0.86 – 0.95; HW: 0.78 – 0.83; IHP: 0.12 – 0.14; ML: 0.62 – 0.68; OHP: 0.30; PeL: 0.26 – 0.28; PeW: 0.12 – 0.14; PpL: 0.14 – 0.16; PpW: 0.22 – 0.24; PsL: 0.06 – 0.08; SL: 0.38 – 0.40; CI: 87 – 91; SI: 45 – 49; HPI: 40 – 47 (n = 3).

**Major worker. Head:** head side, in dorsal view, slightly convex, nearly straight, with standing setae; head dorsal profile with a strong convexity just anterior to the vertexal region, and vertexal margin deeply emarginate. Hypostoma with median tooth vestigial; inner teeth distinct and broad, in mid-distance from outer teeth. Median clypeal carina absent; clypeal disc smooth. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, not surpassing midheight between eye and vertexal margin, with standing setae. Space between eye and frontal carina reticulate-rugose, with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae longitudinally rugulose that gradually become reticulate-rugose at about the posterior half of head dorsum. Vertexal surface, in frontal view, strongly reticulate-rugose. **Mesosoma:** pronotum dorsally reticulate-rugose, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile sinuous, without an anterior concavity and with a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum. **Metasoma:** petiolar peduncle, in profile, with dorsal margin broadly concave, and petiolar node, in lateral view, apically narrow and rounded. Postpetiole, in dorsal view, wider than long and trapezoidal, and dorsally presenting flexuous standing setae. First

gastral tergum smooth; dorsally with flexuous standing setae, more than 1.5× the eye length. Color light yellow.

**Measurements, minor worker:** EL: 0.05 – 0.06; FL: 0.32; HL: 0.43; HW: 0.38 – 0.40; ML: 0.44; PeL: 0.19 – 0.21; PeW: 0.08; PpL: 0.10 – 0.11; PpW: 0.13; PsL: 0.05; SL: 0.33; CI: 89 – 93; SI: 84 – 88 (n = 3).

**Minor worker. Head:** vertexal margin, in dorsal view, emarginate and rounded; occipital carina, in dorsal view, not visible; postgenal bridge, in lateral view, areolate. Anterior clypeal margin not emarginate; clypeal disc smooth. Space between eye and frontal carina strongly areolate, with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae strongly areolate. Vertexal surface strongly areolate. **Mesosoma:** pronotal surface strongly areolate, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile continuous, without a distinctly produced median area, and dropping almost vertically to the propodeum. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, with smoothly rounded side, dorsally smooth, and presenting flexuous standing setae. First gastral tergum smooth; dorsally with flexuous standing setae, no more than 1.5× the eye length. Color light yellow.

**Comments.** Majors can be differentiated from similar species in the *flavens* group by the head dorsal profile anteriorly convex and depressed near the vertexal portion, and the head surface strongly reticulate-rugose, including the space between eye and antennal fossa, frons, and vertexal surface. Minors of *P. abaticanga* are similar to several species included the *flavens* group, so that the complete description must be employed to distinguish it.

The type-series of this species was collected in a leaf-litter sample at a small fragment of semideciduous forest near a stream. The type-locality, *Parque Estadual do Guartelá*, Tibagi, is one of the last well-preserved remnants of the grassland formation known as *Campos Gerais*, exclusively found in the Paraná state, within the Atlantic Forest domain. The landscape consists of large areas of grasslands and shrublands with small enclaves of semideciduous forests.

**Etymology.** From Tupi-Guarani, Old Tupi (see details about the language at the description of *P. abakytan* above), *abati* = corn, *canga* of *akãnga* = head (de Carvalho, 1987), in apposition, referring to the head shape of the major worker. This name was chosen for the way that my labmate Mila Martins typically recognizes and diagnoses this species.

*Pheidole cangussu* n. sp.

urn:lsid:zoobank.org:act:93B2A93C-F8FA-4DAB-B209-E986F7C6B9E2 (Figs. 3, 11)

**Holotype major worker:** Brazil: PR, Jaguaiaíva, Parque Estadual do Cerrado, 804m, 24°10'04.7"S 49°39'59.8"W, 15.i.2005 A. M. Oliveira, R. Feitosa, J. Maravalhas, H. Vasconcelos cols. [CASENT0742941] [DZUP]

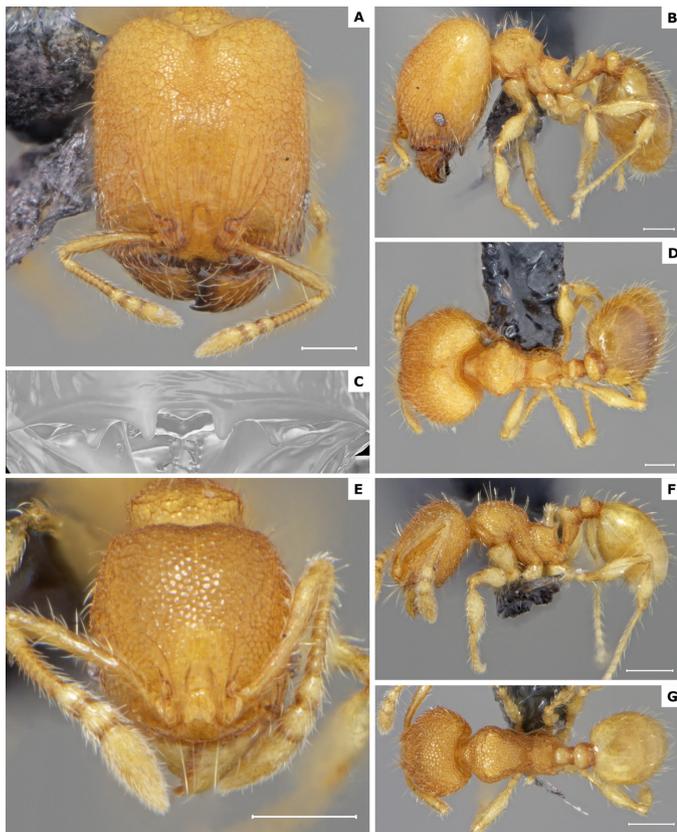
**Paratype one major and 11 minor workers:** same data as holotype [DZUP (8 ♀; DZUP549893, DZUP549897, DZUP549898, DZUP549899, DZUP549900, DZUP549901, DZUP549902, and CASENT0742942); MCZC (2 ♀; DZUP549896 and DZUP549895); MZSP (1 ♂ and 1 ♀; DZUP549892 and DZUP549894)]

**Cybertypes:** holotype, major worker (CASENT0742941) (Supp 5 [online only]) and paratype, minor worker (CASENT0742942) (Supp 6 [online only]), with label transcribed above.

**Additional material:** two ♂ and four ♀: Brazil: PR, Ponta Grossa, P.E. Vila Velha – Campo Limpo, 25°14'52.74"S 49°59'35.01"W, 24-28.XI.2014, W. Franco, R.M. Feitosa, A.C. Ferreira, F. Benatti cols. [DZUP].

**Geographic range.** Brazil: Paraná.

**Measurements, major worker:** EL: 0.18 – 0.20; FL: 1.12 – 1.16; HL: 1.84; HW: 1.44 – 1.52; IHP: 0.30 – 0.36; ML: 1.44 – 1.60; OHP: 0.68,



**Figure 2** *Pheidole abaticanga* n. sp. Major worker, holotype, CASENT0790160: (A) full-face view (B) lateral view (C) hypostomal margin (D) dorsal view. Minor worker, paratype, CASENT0790161: (E) full-face view (F) profile view (G) dorsal view. Scale bar 0.2 mm. 3D model and rotation video (Supp 3 and 4 [online only]).

PeL: 0.50; PeW: 0.20 – 0.22; PpL: 0.34 – 0.38; PpW: 0.34 – 0.38; PsL: 0.08 – 0.13; SL: 0.64 – 0.76; CI: 78 – 83; SI: 44 – 50; HPI: 44 – 53 (n = 2).

**Major worker. Head:** head side, in dorsal view, broadly convex, with standing setae; head dorsal profile forming a smooth, continuous convexity, nearly straight, and vertexal margin deeply emarginate. Hypostoma with median tooth absent; inner teeth distinct and broad, diverging apically. Median clypeal carina distinct; clypeal disc smooth. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, not surpassing midheight between eye and vertexal margin, with standing setae, and anterior margin with some of them longer than the adjacent. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae longitudinally rugulose. Vertexal surface, in frontal view, smooth. **Mesosoma:** pronotum dorsally smooth, and promesonotal dorsum, in lateral view, presenting stiff standing setae. Mesonotal profile continuous, with a distinctly produced median area. Katepisternum finely areolate with smooth median patch and few rugulae. Propodeal projection triangular. **Metasoma:** petiolar peduncle, in profile, with dorsal margin broadly concave, and petiolar node, in lateral view, apically narrow and acute. Postpetiole, in dorsal view, as wide as long and trapezoidal, and dorsally presenting stiff standing setae. First gastral tergum smooth; dorsally with stiff standing setae, no more than 1.5× the eye length. Color light yellowish-brown.

**Measurements, minor worker:** EL: 0.13; FL: 0.63 – 0.65; HL: 0.65 – 0.70; HW: 0.60 – 0.62; ML: 0.90; PeL: 0.30 – 0.33; PeW: 0.10; PpL: 0.18 – 0.28; PpW: 0.14 – 0.16; PsL: 0.03; SL: 0.58 – 0.65; CI: 86 – 92; SI: 96 – 108 (n = 3).

**Minor worker. Head:** vertexal margin, in dorsal view, not emarginate and strongly rounded; occipital carina, in dorsal view, visible; postgenal

bridge, in lateral view, smooth. Anterior clypeal margin not emarginate; clypeal disc smooth. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae smooth with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface smooth. **Mesosoma:** pronotal surface finely areolate, laterally with a smooth posterior patch, dorsally with the pronotal disc smooth, and promesonotal dorsum, in lateral view, presenting stiff standing setae. Mesonotal profile slightly sinuous, without a distinctly produced median area, and gradually inclining to the propodeum. Katepisternum strongly areolate with a smooth anteroventral patch. Propodeal projection triangular; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, with smoothly rounded side, dorsally smooth, and presenting stiff standing setae. First gastral tergum smooth; dorsally with stiff standing setae, no more than 1.5× the eye length. Color light yellowish-brown.

**Comments.** *P. cangussu* resembles *P. schwarzmaieri* Borgmeier. Majors of *P. cangussu* have the mesosoma surface predominantly smooth, while *P. schwarzmaieri* has the surface areolate. Minors of *P. cangussu* have the head smooth and mesosoma finely areolate; *P. schwarzmaieri* has the head and mesosoma distinctly areolate.

The type-series comes from pitfall traps installed at 804 m in the *Parque Estadual do Cerrado*, Jaguaariáiva, Paraná (see details about the locality at the description of *P. abakytan* above).

**Etymology.** From Tupi-Guarani, Old Tupi (see details about the language at the description of *P. abakytan* above), *cang* of *akánga* = head, *ussu* of *uçu* = big (de Carvalho, 1987), in apposition, referring to the large head of the major worker.

#### *Pheidole curupira* n. sp.

urn:lsid:zoobank.org:act:27A06043-4D88-4B25-AB53-DEE769B54C5A (Figs. 4, 11)

**Holotype major worker:** Brazil: PR, Ponta Grossa, P.E. Vila Velha, 25° 14' 52.74" S 49° 59' 35.01" W, 19-22.xii.2016 R. Feitosa, W. Franco, A.C. Neundorf, Y.S. Moreira cols. [CASENT0742949] [DZUP]

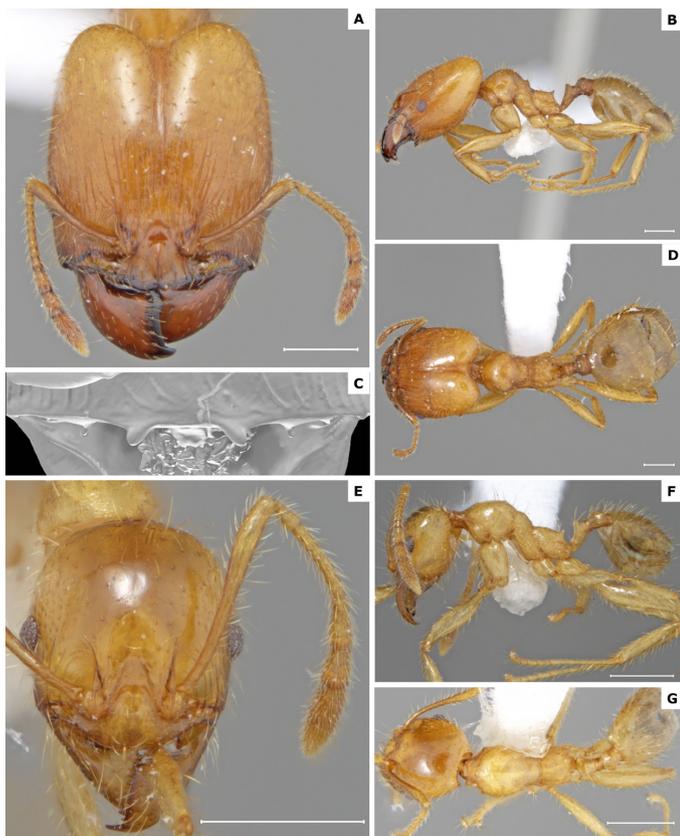
**Paratype two major and eight minor workers:** same data as holotype [DZUP (4 ♂; DZUP549909, DZUP549911, DZUP549910, and CASENT0742950); MCZC (1 ♀ and 2 ♂; DZUP549904, DZUP549907, and DZUP549908); MZSP (1 ♀ and 2 ♂; DZUP549903, DZUP549905, and DZUP549906)]

**Cybertypes:** holotype, major worker (CASENT0742949) (Supp 7 [online only]) and paratype, minor worker (CASENT0742950) (Supp 8 [online only]), with label transcribed above.

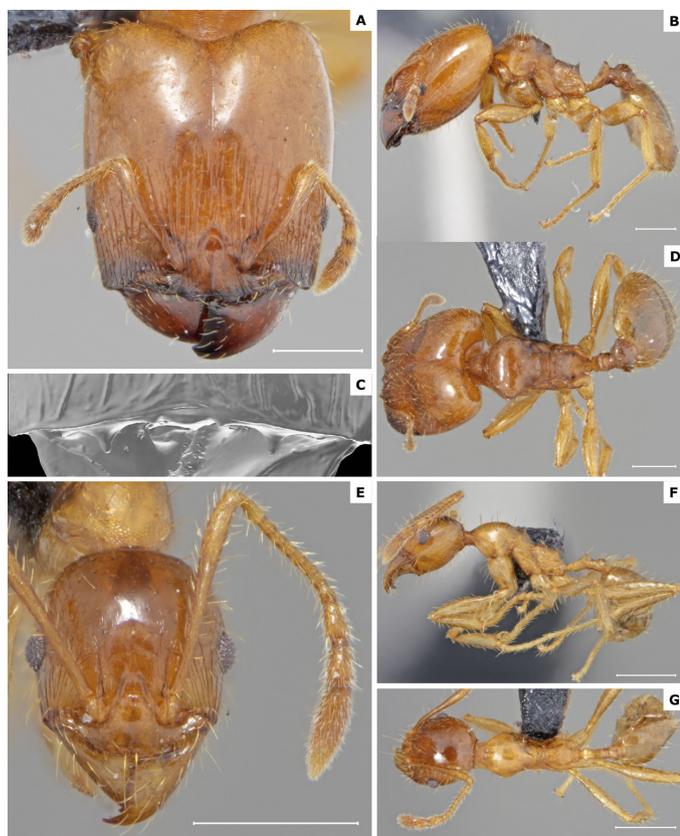
**Geographic range.** Brazil: Paraná.

**Measurements, major worker:** EL: 0.13 – 0.16; FL: 0.85 – 0.92; HL: 1.60 – 1.72; HW: 1.36 – 1.52; IHP: 0.20 – 0.25; ML: 1.28 – 1.32; OHP: 0.50 – 0.55; PeL: 0.43 – 0.48; PeW: 0.23 – 0.25; PpL: 0.32 – 0.35; PpW: 0.45 – 0.50; PsL: 0.08; SL: 0.60 – 0.64; CI: 85 – 88; SI: 42 – 44; HPI: 40 – 45 (n = 2).

**Major worker. Head:** head side, in dorsal view, broadly convex, with standing setae; head dorsal profile forming a smooth, continuous convexity, nearly straight, and vertexal margin moderately emarginate. Hypostoma with median tooth vestigial; inner teeth vestigial, closely spaced. Median clypeal carina vestigial; clypeal disc smooth. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, not surpassing superior limit of the eye, with standing setae. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally, and with a reticulate-rugose patch. Space between frontal carinae longitudinally rugulose. Vertexal surface, in frontal view, smooth. **Mesosoma:** pronotum dorsally smooth, anteriorly with transverse, straight to slightly curved rugulae, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile



**Figure 3** *Pheidole cangussu* n. sp. Major worker, holotype, CASENT0742941: (A) full-face view (B) lateral view (C) hypostomal margin (D) dorsal view. Minor worker, paratype, CASENT0742942: (E) full-face view (F) profile view (G) dorsal view. Scale bar 0.5 mm. 3D model and rotation video (Supp 5 and 6 [online only]).



**Figure 4** *Pheidole curupira* n. sp. Major worker, holotype, CASENT0742949: (A) full-face view (B) lateral view (C) hypostomal margin (D) dorsal view. Minor worker, paratype, CASENT0742950: (E) full-face view (F) profile view (G) dorsal view. Scale bar 0.5 mm. 3D model and rotation video (Supp 7 and 8 [online only]).

continuous, without a distinctly produced median area, and dropping almost vertically to the propodeum. Katepisternum finely areolate with smooth median patch. Propodeal projection spiniform, not as long as posterior face of propodeum. **Metasoma:** petiolar peduncle, in profile, with dorsal margin broadly concave, and petiolar node, in lateral view, apically narrow and rounded. Postpetiole, in dorsal view, wider than long and trapezoidal, and dorsally presenting flexuous standing setae. First gastral tergum smooth; dorsally with flexuous standing setae, no more than 1.5× the eye length. Color yellowish-brown.

**Measurements, minor worker:** EL: 0.10 – 0.13; FL: 0.58 – 0.65; HL: 0.63 – 0.68; HW: 0.55 – 0.60; ML: 0.83 – 0.90; PeL: 0.26 – 0.30; PeW: 0.08 – 0.10; PpL: 0.13 – 0.15; PpW: 0.14 – 0.18; PsL: 0.02 – 0.03; SL: 0.63 – 0.65; CI: 85 – 89; SI: 104 – 114 (n = 3).

**Minor worker. Head:** vertexal margin, in dorsal view, not emarginate and strongly rounded; occipital carina, in dorsal view, visible; postgenal bridge, in lateral view, smooth. Anterior clypeal margin not emarginate; clypeal disc smooth. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae smooth with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface smooth with few piligerous punctures. **Mesosoma:** pronotal surface finely areolate, laterally with a smooth posterior patch, dorsally with the pronotal disc smooth, and promesonotal dorsum, in lateral view, presenting stiff standing setae. Mesonotal profile slightly sinuous, without a distinctly produced median area, and gradually inclining to the propodeum. Katepisternum strongly areolate. Propodeal projection vestigial; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, trapezoidal, dorsally smooth, and presenting stiff standing

setae. First gastral tergum smooth; dorsally with stiff standing setae, no more than 1.5× the eye length. Color yellowish-brown.

**Comments.** *Pheidole curupira* resembles *P. gigaflavens* Wilson, 2003. Majors of *P. curupira* have the pronotal surface mostly smooth, while *P. gigaflavens* has this surface areolate. Minors of *P. curupira* have the head mostly smooth, and *P. gigaflavens* has the head strongly areolate.

The *P. curupira* type-series was collected with pitfall traps in the Parque Estadual de Vila Velha, Ponta Grossa, Paraná. The landscape consists of vast extensions of grasslands and shrublands, with small forest enclaves within the Atlantic Forest domain.

**Etymology.** In apposition, from Brazilian folklore, the *curupira* has many representations throughout the country, but the common depiction refers to him as a dwarf with red hair, feet in reverse and heels forward so that footprints confound those who are looking for him in the jungle. The name was chosen to honor Brazilian culture, in addition to referring to the small size of this species.

*Pheidole idiota* rev. stat.

(Figs. 5, 12)

*Pheidole idiota* Santschi, 1923: 53 (major worker, minor and queen). Lectotype major (CASENT0913471; here designated) and paralectotype minor (CASENT0913472; here designated) worker. Argentina: Córdoba, Alta Gracia. [NHMB] (image examined). Santschi, 1929: 284: subspecies of *P. vafra* Wilson, 2003: 244: as junior synonym of *P. vafra*.

*Pheidole vafra idiota maculifrons* Santschi, 1929: 53 (major worker, minor and queen). Lectotype major (CASENT0913473; here designated) and paralectotype minor (CASENT0913474; here designated) worker. Argentina: Córdoba, Alta Gracia [NHMB] (image examined). Brown, 1981: 526: as junior synonym of *P. vafra idiota* and unavailable name, junior homonym of *P. maculifrons* Wheeler, 1928.

*Pheidole laticornis* Wilson, 2003: 203 (major and minor worker). Holotype major and paratype minor worker. Costa Rica: Palmar, Puntarenas. [MCZC] (examined). Longino, 2019: 63: as junior synonym of *P. vafra*. **New synonym.**

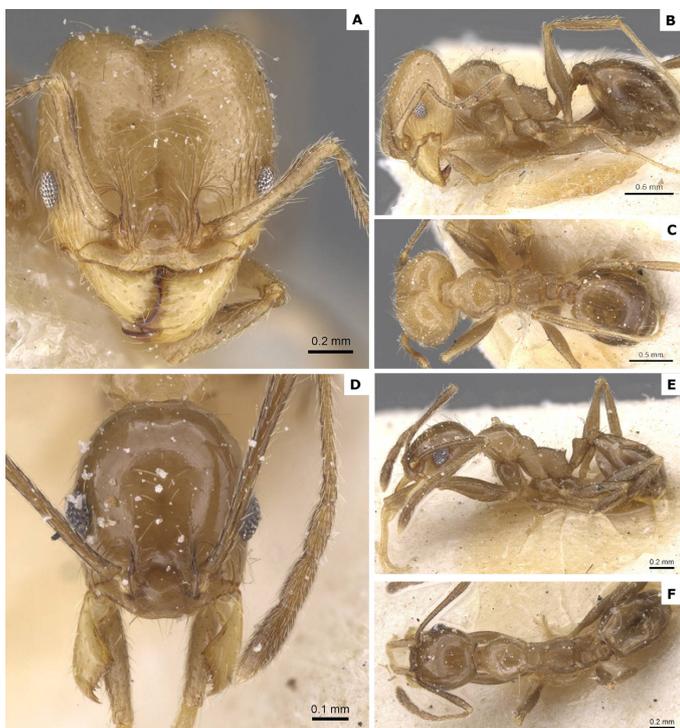
**Additional material:** 12 ♀: Brazil: PR, Jaguariaíva, Parque Estadual do Cerrado, 804m, 24°10'04.7"S 49°39'59.8"W, 15.i.2015, A.M. Oliveira, R. Feitosa, J. Maravalhas, H. Vasconcelos cols. [DZUP]; four ♀: Brazil: PR, Jaguariaíva, Parque Estadual do Cerrado, 899m, 24°10'47.6"S 49°40'05.5"W, 15.i.2015, A.M. Oliveira, R. Feitosa, J. Maravalhas, H. Vasconcelos cols. [DZUP]; three ♂ and 11 ♀: Brazil: PR, Jaguariaíva, Parque Estadual do Cerrado, 917m, 24°11'15.9"S 49°39'53.1"W, 15.i.2015, A.M. Oliveira, R. Feitosa, J. Maravalhas, H. Vasconcelos cols. [DZUP]; two ♀: Brazil: PR, Tibagi, P.E. do Guartelá, Trilha do Rio, winkler, 24°33'49.61"S 50°15'32.36"W, 20-25.IX.2015, W. Franco, R.M. Feitosa, A. Machado cols. [DZUP]; five ♂ and 14 ♀: Brazil: PR, Ponta Grossa, P.E. Vila Velha – Campo Limpo, 25°14'52.74"S 49°59'5.01"W, 19-22.XII.2016, R.M. Feitosa, W. Franco, A.C. Neundorf, Y.S. Moreira cols. [DZUP]; six ♂ and four ♀: Brazil: PR, Ponta Grossa, P.E. Vila Velha – Campo Sujo, 25°14'37.85"S 50°00'44.05"W, 19-22.XII.2016, R.M. Feitosa, W. Franco, A.C. Neundorf, Y.S. Moreira cols. [DZUP]; two ♂ and 18 ♀: Brazil: PR, Tibagi, P.E. do Guartelá, Transecto 1 (C. Pastejado), 24°34'7.18"S 50°15'33.72"W, 20-25.IX.2015, W. Franco, R.M. Feitosa, A. Machado cols. [DZUP]; three ♀: Brazil: PR, Tibagi, P.E. do Guartelá, Transecto 2 (C. Alto), 24°34'18.36"S 50°15'4.80"W, 20-25.IX.2015, W. Franco, R.M. Feitosa, A. Machado cols. [DZUP]; one ♂ and three ♀: Brazil: PR, Tibagi, P.E. do Guartelá, Transecto 3 (Cerrado), 24°33'47.86"S 50°15'14.29"W, 20-25.IX.2015, W. Franco, R.M. Feitosa, A. Machado col. [DZUP]; two ♂ and one ♀: Brazil: SC, Xanxerê, Oeste, 723m XII.2011-12-12, 353933.0849 (UTM long) 7031745.381 (UTM lat),

M.L.C. Bartz et al. cols. [DZUP]; one ♂ and two ♀: Brazil: SC, Chapecó, Oeste, 640m XII.2011-I.2012, 336913.9338 (UTM long) 7002703.673 (UTM lat) M.L.C. Bartz et al. cols. [DZUP].

**Geographic range.** Argentina: Córdoba; Brazil: Paraná and Santa Catarina; and Costa Rica: Palmar.

**Measurements, major worker:** EL: 0.16 – 0.18; FL: 0.80 – 0.88; HL: 1.04 – 1.08; HW: 0.96 – 1.00; IHP: 0.32 – 0.34 ML: 1.12 – 1.20; OHP: 0.44 – 0.48; PeL: 0.38 – 0.44; PeW: 0.18; PpL: 0.20 – 0.24; PpW: 0.23 – 0.24; PsL: 0.08; SL: 0.72 – 0.76; CI: 92 – 93; SI: 72 – 79; HPI: 67 – 77 (n = 3).

**Major worker. Head:** head side, in dorsal view, broadly convex, with standing setae; head dorsal profile forming a broadly, continuous convexity, and vertexal margin deeply emarginate. Hypostoma with median tooth vestigial; inner teeth distinct, narrow and straight, widely spaced. Median clypeal carina absent; clypeal disc smooth. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, surpassing midheight between eye and vertexal margin but not reaching the margin, and basally terete; with a combination of appressed setae and standing. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae smooth with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface, in frontal view, smooth. **Mesosoma:** pronotum dorsally smooth, anteriorly with transverse, straight to slightly curved rugulae, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection triangular. **Metasoma:** petiolar peduncle, in profile, with dorsal margin broadly concave, and petiolar node, in lateral view, broad and apically rounded. Postpetiole, in dorsal view, as wide as long and trapezoidal, and dorsally presenting flexuous standing setae. First gastral tergum smooth; dorsally with flexuous standing setae, no more than 1.5× the eye length. Color dark brown.



**Figure 5** *Pheidole idiota* rev. stat. Major worker, syntype, CASENT0913471: (A) full-face view (B) lateral view (C) dorsal view. Minor worker, syntype, CASENT0913472: (D) full-face view (E) profile view (F) dorsal view. Image font: AntWeb.org; photographer: Will Ericson.

**Measurements, minor worker:** EL: 0.13 – 0.15; FL: 0.55 – 0.63; HL: 0.55 – 0.58; HW: 0.45; ML: 0.73 – 0.83; PeL: 0.25 – 0.28; PeW: 0.08 – 0.10; PpL: 0.13 – 0.15; PpW: 0.12 – 0.13; PsL: 0.04 – 0.05; SL: 0.70 – 0.75; CI: 78 – 82; SI: 156 – 167 (n = 3).

**Minor worker. Head:** vertexal margin, in dorsal view, not emarginate and strongly rounded; occipital carina, in dorsal view, visible; postgenal bridge, in lateral view, smooth. Anterior clypeal margin not emarginate; clypeal disc smooth. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae smooth with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface smooth. **Mesosoma:** pronotal surface finely areolate, and promesonotal dorsum, in lateral view, presenting stiff standing setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection triangular; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, with straight side, dorsally smooth, and presenting stiff standing setae. First gastral tergum smooth; dorsally with stiff standing setae, no more than 1.5× the eye length. Color dark brown.

**Comments.** *Pheidole idiota* can be easily recognized by the basally broad scape which surpasses the midheight between the eyes and the vertexal margin, not reaching the margin. The only morphologically similar species is *Pheidole porcula* Wheeler. Both species can be distinguished by the gaster pilosity, which in *P. idiota* the setae have no more than 1.5× the eye length, while in *P. porcula* the setae are more than 1.5× the eye length. Minors of *P. idiota* are similar to several species included in the *diligens* group and the complete description is necessary to distinguish them.

This species has been a junior synonym of *Pheidole vafra* since Wilson (2003). Wilson (2003) described *Pheidole laticornis* and considered the scape basally broad of majors as the main diagnostic character of the species. However, *P. idiota* presents the same character and lacks any significant morphological difference when compared to *P. laticornis*. In a recent publication, Longino (2019) synonymized *P. laticornis* under *Pheidole vafra*, considering the similarity between the images of both types. After examining a large number of specimens, including the sympatric populations of Paraná state (see Franco & Feitosa (2018) for the records), as well the type series and its synonyms, we consider that *P. vafra* can be securely distinguished from *P. idiota* by the consistency of the diagnosis above. We revive *P. idiota* to species with *P. laticornis* as its junior synonym.

The current disjunct distribution of *P. idiota* is probably an artifact from the fact that several records for the species in Mesoamerica and southern South America have been attributed to *P. laticornis* and *P. vafra*, respectively.

*Pheidole mapinguari* n. sp.

urn:lsid:zoobank.org:act:4D420C17-B65C-44CC-8C5D-B0371D384941 (Figs. 6, 11)

**Holotype major worker:** Brazil: PR, Ponta Grossa, P.E. Vila Velha, 25°14'52.74"S 49°59'35.01"W, 24-28.xi.2014 W. Franco, R.M. Feitosa, A.C. Ferreira, F. Benatti cols. [CASENT0742947] [DZUP]

**Paratype eight minor workers:** same data as holotype [DZUP (2 ♀; DZUP549921 and CASENT0742948); MCZC (3 ♂; DZUP549918, DZUP549919, and DZUP549920); MZSP (3 ♀; DZUP549915, DZUP549916, and DZUP549917)]

**Cybertypes:** holotype, major worker (CASENT0742947) (Supp 9 [online only]) and paratype, minor worker (CASENT0742948) (Supp 10 [online only]), with label transcribed above.

**Additional material:** four ♂ and five ♀: Brazil: PR, Jaguariáiva, Parque Estadual do Cerrado, 804m, 24°10'04.7"S 49°39'59.8"W, 15.i.2015, A.M. Oliveira, R. Feitosa, J. Maravalhas, H. Vasconcelos cols. [DZUP]; five ♀: Brazil: PR, Jaguariáiva, Parque Estadual do Cerrado, 917m, 24°11'15.9"S 49°39'53.1"W, 15.i.2015, A.M. Oliveira, R. Feitosa, J. Maravalhas, H. Vasconcelos cols. [DZUP]; five ♀: Brazil: PR, Palmas, R.V.S.C.P. Transecto 2, 26°30'11.05"S 51°40'33.98"W, 19-22.XII.2016, R. Feitosa, W. Franco, P. Andrade cols. [DZUP]; three ♀: Brazil: PR, Palmas, R.V.S.C.P. Transecto 3, 26°30'38.57"S 51°40'22.40"W, 19-22.XII.2016, R. Feitosa, W. Franco, P. Andrade cols. [DZUP]; one ♀: Brazil: PR, Ponta Grossa, P.E. Vila Velha – Campo Sujo, 25°14'37.85"S 50°00'44.05"W, 24-28.XI.2014, W. Franco, R.M. Feitosa, A.C. Ferreira, F. Benatti cols. [DZUP]; three ♀: Brazil: PR, Tibagi, P.E. do Guartelá, Transecto 1 (C. Pastejado), 24°34'7.18"S 50°15'33.72"W, 20-25.IX.2015, W. Franco, R.M. Feitosa, A. Machado cols. [DZUP]; one ♂: Brazil: PR, Tibagi, P.E. do Guartelá, Transecto 2 (C. Alto), 24°34'18.36"S 50°15'4.80"W, 20-25.IX.2015, W. Franco, R.M. Feitosa, A. Machado col. [DZUP]; one ♂ and 26 ♀: Brazil: PR, Tibagi, P.E. do Guartelá, Transecto 3 (Cerrado), 24°33'47.86"S 50°15'14.29"W, 20-25.IX.2015, W. Franco, R.M. Feitosa, A. Machado cols. [DZUP]; one ♂: Brazil: RS, Jaquirana, 29°5'43"S 50°22'02"W, Managed Natural Grassland, Traditional Grazing Plot (COM), pitfall trap, XII.2014 [DZUP].

**Geographic range.** Brazil: Paraná and Rio Grande do Sul.

**Measurements, major worker:** EL: 0.20; FL: 0.88; HL: 1.12; HW: 1.12; IHP: 0.42; ML: 1.08; OHP: 0.48, PeL: 0.40; PeW: 0.20; PpL: 0.23; PpW: 0.28; PsL: 0.13; SL: 0.84; CI: 100; SI: 75; HPI: 88 (n = 1).

**Major worker. Head:** head side, in dorsal view, broadly convex, with standing setae; head dorsal profile forming a broadly, continuous convexity, and vertexal margin shallowly emarginate. Hypostoma with median tooth vestigial; inner teeth distinct, narrow and slightly curved,

converging apically, and widely spaced. Median clypeal carina absent; clypeal disc predominantly smooth, with few rugulae. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, surpassing midheight between eye and vertexal margin but not reaching the margin, with a combination of appressed setae and standing. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally, and with a reticulate-rugose patch. Space between frontal carinae smooth with few longitudinal rugulae extending posteriorly from frontal lobe with interspaces finely areolate. Vertexal surface, in frontal view, smooth. **Mesosoma:** pronotum dorsally finely areolate with humeral area reticulate-rugose, and with few sparse rugulae, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum. **Metasoma:** petiolar peduncle, in profile, with dorsal margin broadly concave, and petiolar node, in lateral view, broad and apically rounded. Postpetiole, in dorsal view, as wide as long and trapezoidal, and dorsally presenting flexuous standing setae. First gastral tergum finely areolate; dorsally with flexuous standing setae, more than 1.5× the eye length. Color reddish-brown.

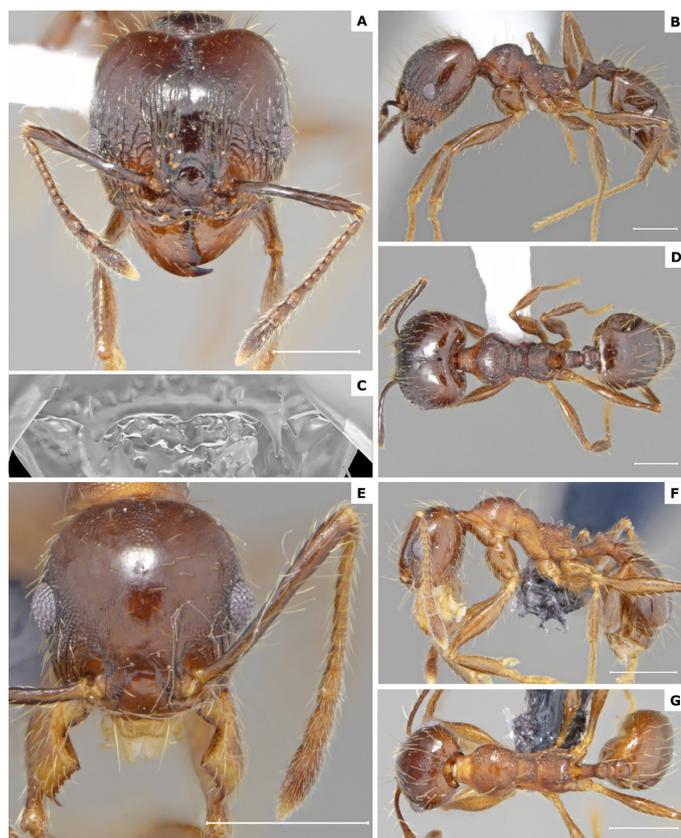
**Measurements, minor worker:** EL: 0.15; FL: 0.68 – 0.70; HL: 0.65 – 0.73; HW: 0.60 – 0.63; ML: 0.85 – 0.90; PeL: 0.28; PeW: 0.12 – 0.13; PpL: 0.13 – 0.15; PpW: 0.15 – 0.16; PsL: 0.08; SL: 0.70 – 0.75; CI: 86 – 92; SI: 117 – 125 (n = 3).

**Minor worker. Head:** vertexal margin, in dorsal view, not emarginate and strongly rounded; occipital carina, in dorsal view, not visible; postgenal bridge, in lateral view, smooth. Anterior clypeal margin emarginate; clypeal disc smooth. Space between eye and frontal carina strongly areolate, with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae finely areolate with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface finely areolate. **Mesosoma:** pronotal surface finely areolate, laterally with a smooth posterior patch, dorsally with few transverse rugulae anteriorly, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, with smoothly rounded side, dorsally smooth, and presenting flexuous standing setae. First gastral tergum finely areolate; dorsally with flexuous standing setae, no more than 1.5× the eye length. Color reddish-brown.

**Comments.** *Pheidole mapinguari* is similar to *P. longiseta* Wilson. Majors and minors of *P. mapinguari* have the pronotal dorsum areolate with few rugulae anteriorly; and *P. longiseta* has the pronotal dorsum smooth.

This is one of the most common species found in the *Parque Estadual de Vila Velha*, Ponta Grossa, Paraná. Specimens were mostly collected with pitfall traps in different phytophysionomies, including open grasslands and shrublands.

**Etymology.** In apposition, from Brazilian folklore, the *mapinguari* is a large, black creature, with long hands, clawed nails, and long hair covering its body like a cloak. This name was chosen to honor Brazilian popular culture, in addition to making reference to the dark color and the long gastral pilosity of major workers, with more than 1.5× the eye length.



**Figure 6** *Pheidole mapinguari* n. sp. Major worker, holotype, CASENT0742947: (A) full-face view (B) lateral view (C) hypostomal margin (D) dorsal view. Minor worker, paratype, CASENT0742948: (E) full-face view (F) profile view (G) dorsal view. Scale bar 0.5 mm. 3D model and rotation video (Supp 9 and 10 [online only]).

*Pheidole obapara* n. sp.

urn:lsid:zoobank.org:act:E51B206A-3F7D-41C8-8295-462D02E0AA50 (Figs. 7, 11)

**Holotype major worker:** Brazil: PR, Tibagi, P.E. do Guartelá, 24°33'49.61'S 50°15'32.36'W, 20-25.ix.2015 W. Franco, R.M. Feitosa, A. Machado cols. [CASENT0790158] [DZUP]

**Paratype one major and three minor workers:** same data as holotype [DZUP (2 ♂: DZUP549914 and CASENT0790159); MCZC (1 ♀ and 1 ♂: DZUP549912 and DZUP549913)]

**Cybertypes:** holotype, major worker (CASENT0790158) (Supp 11 [online only]) and paratype, minor worker (CASENT0790159) (Supp 12 [online only]), with label transcribed above.

**Geographic range.** Brazil: Paraná.

**Measurements, major worker:** EL: 0.10; FL: 0.55; HL: 0.95; HW: 0.80 – 0.85; IHP: 0.18 – 0.23; ML: 0.80 – 0.83; OHP: 0.28 – 0.32; PeL: 0.30 – 0.33; PeW: 0.14 – 0.16; PpL: 0.15 – 0.18; PpW: 0.26; PsL: 0.05; SL: 0.38 – 0.40; CI: 84 – 89; SI: 44 – 50; HPI: 56 – 80 (n = 2).

**Major worker. Head:** head side, in dorsal view, slightly convex, nearly straight, with standing setae; head dorsal profile with a strong convexity just anterior to the vertexal region, and vertexal margin deeply emarginate. Hypostoma with median tooth distinct; inner teeth distinct and broad, in mid-distance from outer teeth. Median clypeal carina absent; clypeal disc smooth. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, not surpassing midheight between eye and vertexal margin, with standing setae. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally, and with a reticulate-rugose patch. Space between frontal carinae with curved rugulae extending from one frontal lobe to another and that gradually become transverse posteriorly, with interspaces finely areolate. Antennal scrobe, in frontal view, shallow and areolate, delimited posteriorly by a curved rugulae. Vertexal surface, in frontal view, transversally rugulose with few reticulate-rugose areas. **Mesosoma:**

pronotum dorsally transversally rugulose, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile sinuous, without an anterior concavity and with a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum. **Metasoma:** petiolar peduncle, in profile, with dorsal margin broadly concave, and petiolar node, in lateral view, apically narrow and rounded. Postpetiole, in dorsal view, as wide as long and trapezoidal, and dorsally presenting flexuous standing setae. First gastral tergum smooth; dorsally with flexuous standing setae, no more than 1.5× the eye length. Color light yellowish-brown.

**Measurements, minor worker:** EL: 0.10; FL: 0.40; HL: 0.48 – 0.50; HW: 0.44 – 0.46; ML: 0.58; PeL: 0.20 – 0.22; PeW: 0.08; PpL: 0.10 – 0.12; PpW: 0.10 – 0.12; PsL: 0.02; SL: 0.40 – 0.42; CI: 92 – 115; SI: 87 – 95 (n = 2).

**Minor worker. Head:** vertexal margin, in dorsal view, emarginate and rounded; occipital carina, in dorsal view, not visible; postgenal bridge, in lateral view, smooth. Anterior clypeal margin not emarginate; clypeal disc smooth. Space between eye and frontal carina strongly areolate, with sparse concentric, and a few longitudinal rugulae laterally, and with a reticulate-rugose patch. Space between frontal carinae strongly areolate with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface strongly areolate. **Mesosoma:** pronotal surface strongly areolate, and promesonotal dorsum, in lateral view, presenting stiff standing setae. Mesonotal profile continuous, without a distinctly produced median area, and slightly inclining to the propodeum. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, trapezoidal, dorsally smooth, and presenting stiff standing setae. First gastral tergum smooth; dorsally with stiff standing setae, no more than 1.5× the eye length. Color light yellowish-brown.

**Comments.** *Pheidole obapara* is similar to *Pheidole transversostriata* Mayr. In both species, majors have curved rugulae in the space between the frontal carinae, which extend from one frontal lobe to the other, becoming gradually transversal posteriorly. Majors of *P. obapara* have the head dorsal profile anteriorly convex and depressed near the vertexal portion, and the interspaces among the face rugulae areolate; *P. transversostriata* has the dorsal profile broadly convex, and the interspaces smooth.

Specimens of *P. obapara* described here were collected in a leaf-litter sample within a small fragment of semideciduous forest beside a stream in the *Parque Estadual do Guartelá*. See details about the type-locality under the description of *P. abaticanga* above.

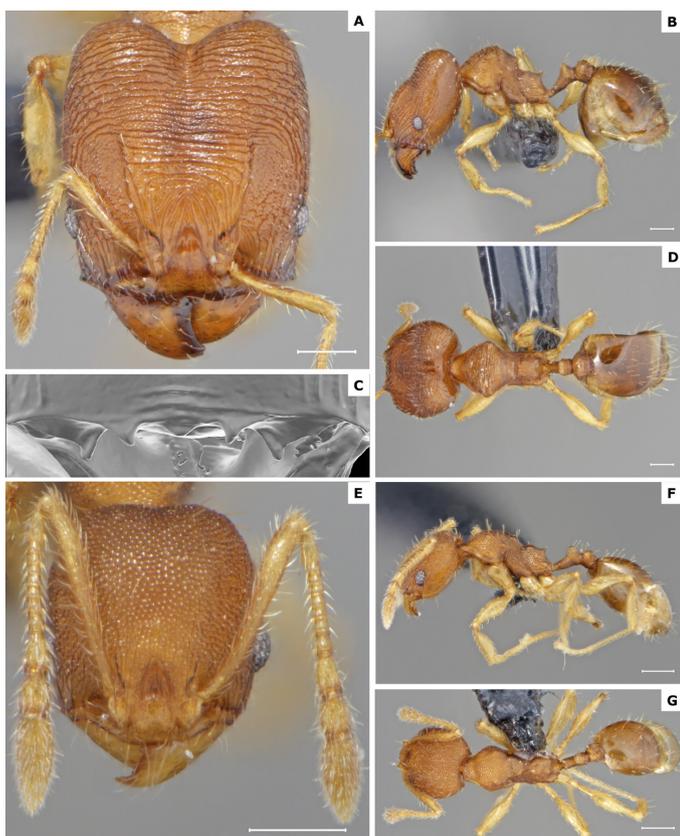
**Etymology.** From Tupi-Guarani, Old Tupi (see details about the language at the description of *P. abakytan* above) *obá* = face, *apará* = crooked (de Carvalho, 1987), in apposition, referring to the discontinuous dorsal profile of the major worker.

#### *Pheidole obscurior* rev. stat.

(Figs. 8, 12)

*Pheidole susanna obscurior* Forel, 1886: xlv (major and minor worker). Lectotype major (JTL000015316) and paralectotype minor (JTL000015317) worker (here designated). Brazil: Rio de Janeiro [MHNG] (image examined). Forel, 1893: 410: queen and male description. Wilson, 2003: 330: raised to species. Longino, 2009: 79: as junior synonym of *P. susanna*.

*Pheidole partita* Mayr, 1887: 590 (major worker) 604 (minor worker). Lectotype major (CASENT0916067) worker and paralectotype minor (CASENT0919784) worker (here designated). Brazil: Rio de Janeiro. [NHMW] (image examined). Wilson, 2003: 330: as



**Figure 7** *Pheidole obapara* n. sp. Major worker, holotype, CASENT0790158: (A) full-face view (B) lateral view (C) hypostomal margin (D) dorsal view. Minor worker, paratype, CASENT0790159: (E) full-face view (F) profile view (G) dorsal view. Scale bar 0.2 mm. 3D model and rotation video (Supp 11 and 12 [online only]).

junior synonym of *P. obscurior*. Longino, 2009: 79: as junior synonym of *P. susanna*. **New synonym.**

*Pheidole incisa evoluta* Borgmeier, 1929: 204, pl. 6, Fig. 3 (major and minor worker). Lectotype major (CASENT0913456; here designated) and paralectotype minor (CASENT0913457; here designated) worker. Brazil: Rio Grande do Sul, Porto Alegre. [NHMB] (image examined). Kempf, 1964: 63: as junior synonym of *P. susanna*. **New synonym.**

**Additional material:** one ♂ and 10 ♀: Brazil: PR, Ponta Grossa, P.E. Vila Velha – Campo Sujo, 25°14'37.85"S 50°00'44.05"W, 19-22.XII.2016, R.M. Feitosa, W. Franco, A.C. Neundorf, Y.S. Moreira cols. [DZUP]; one ♂ and five ♀: Brazil: PR, Ponta Grossa, P.E. Vila Velha – Fortaleza, 25°13'7.51"S 50°0'2.08"W, 19-22.XII.2016, R.M. Feitosa, W. Franco, A.C. Neundorf, Y.S. Moreira cols. [DZUP]; one ♂: Brasil: PR, Tibagi, P.E. do Guartelá, Transecto 3 (Cerrado), 24°33'47.86S 50°15'14.29W, 20-25.ix.2015, W. Franco, R.M. Feitosa, A.M. Machado cols. [DZUP]; two ♀: Brazil: SC, Lages, Planalto, 859m, Sta GTer. Do Salto, XII.2011-I.2012, 539441.7137 (UTM long) 6925116.989 (UTM lat), M.L.C. Bartz et al. cols [DZUP].

**Geographic range.** Brazil: Paraná, Rio de Janeiro, Rio Grande do Sul, and Santa Catarina.

**Measurements, major worker:** EL: 0.20; FL: 1.09 – 1.23; HL: 1.31 – 1.41; HW: 1.50 – 1.56; IHP: 0.40 – 0.43; ML: 1.32 – 1.34; OHP: 0.56 – 0.60; PeL: 0.48 – 0.50; PeW: 0.18 – 0.20; PpL: 0.24 – 0.27; PpW: 0.25 – 0.30; PsL: 0.06 – 0.08; SL: 1.09 – 1.10; Cl: 111 – 114; SI: 70 – 73; HPI: 71 (n = 3).

**Major worker. Head:** head side, in dorsal view, broadly convex, with standing setae; head dorsal profile forming a broadly, continuous convexity, and vertexal margin deeply emarginate. Hypostoma with median tooth distinct; inner teeth distinct, narrow and slightly curved, converging apically, and widely spaced. Median clypeal carina absent; clypeal disc predominantly smooth, with few rugulae. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, surpassing

midheight between eye and vertexal margin but not reaching the margin, with a combination of appressed setae and standing. Space between eye and frontal carina reticulate-rugose, with sparse concentric, and a few longitudinal rugulae laterally, and interspaces finely areolate. Space between frontal carinae longitudinally rugulose, with interspaces finely areolate. Vertexal surface, in frontal view, smooth. **Mesosoma:** pronotum dorsally finely areolate with few transverse rugulae, and promesonotal dorsum, in lateral view, presenting a combination of few flexuous standing setae and dense, shorter, thin and apically curved setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum. **Metasoma:** petiolar peduncle, in profile, with dorsal margin narrowly concave, and petiolar node, in lateral view, broad and apically rounded. Postpetiole, in dorsal view, as wide as long and trapezoidal, and dorsally presenting flexuous standing setae. First gastral tergum strongly areolate; dorsally with flexuous standing setae, no more than 1.5× the eye length. Color light reddish-brown.

**Measurements, minor worker:** EL: 0.15 – 0.16; FL: 0.76 – 0.85; HL: 0.70 – 0.74; HW: 0.50 – 0.57; ML: 0.90 – 1.05; PeL: 0.30 – 0.33; PeW: 0.10 – 0.11; PpL: 0.14; PpW: 0.16; PsL: 0.05; SL: 0.98 – 1.03; Cl: 130 – 140; SI: 139 (n = 3).

**Minor worker. Head:** vertexal margin, in dorsal view, not emarginate and strongly rounded; occipital carina, in dorsal view, visible; postgenal bridge, in lateral view, smooth. Anterior clypeal margin not emarginate; clypeal disc predominantly smooth, with few rugulae. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally, and interspaces finely areolate. Space between frontal carinae smooth with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface finely areolate. **Mesosoma:** pronotal surface finely areolate, laterally with a smooth posterior patch, and promesonotal dorsum, in lateral view, presenting a combination of few flexuous standing and comparatively longer setae, with dense, shorter, thin and apically curved setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, trapezoidal, dorsally strongly areolate, and presenting flexuous standing setae. First gastral tergum finely areolate; dorsally with flexuous standing setae, no more than 1.5× the eye length. Color light reddish-brown.

**Comments.** Similar species are *P. cardinalis* Wilson and *P. susanna* Forel. Majors of *P. obscurior* have the vertexal surface smooth, while in *P. cardinalis* it is sculptured. In addition, the pronotal dorsum of *P. obscurior* is strongly areolate, with few rugulae in majors, and with a combination of few standing flexuous and comparatively longer hairs, with dense, shorter, thin and apically curved hairs; while the pronotal surface of *P. susanna* is finely areolate in majors, bearing standing hairs only. Finally, sympatric populations between both species are unknown.

In previous studies (Forel 1886; Wilson, 2003), the authors recognized that differences between *P. obscurior* and *P. susanna* were mainly related to the color pattern. Longino (2009) synonymized *P. obscurior* under *P. susanna* considering that the color pattern is variable in this widespread species. However, *P. obscurior* presents a very distinct pilosity pattern and pronotal sculpture, which was not recognized by previous authors. The same pilosity pattern and the overall morphology of *P. obscurior* is shared with *P. partita* Mayr and *P. incisa evoluta* Borgmeier. We revive *P. obscurior* to species with *P. partita* and *P. incisa evoluta* as its junior synonyms.



**Figure 8** *Pheidole obscurior* rev. stat. Major worker, lectotype, JTLCO00015316: (A) full-face view (B) lateral view (C) dorsal view. Minor worker, paralectotype, JTLCO00015317: (D) full-face view (E) profile view (F) dorsal view. Image font: AntWeb.org; Photographer: John T. Longino.

*Pheidole paranana* rev. stat. et n. stat.  
(Figs. 9, 12)

*Pheidole triconstricta paranana* Santschi, 1925 [1924]: 13 (major worker). Lectotype major (CASENT0913465; here designated) and paralectotype minor (CASENT0913466; here designated) worker. Brazil: Paraná, Rio Negro. [NHMB] (image examined). Wilson, 2003: 221: as junior synonym of *P. radoszkowskii*.

**Additional material:** 65 ♀: Brazil: PR, Palmas, R.V.S.C.P. Transecto 1, 26°30'30"S 51°40'8.12"W, 19-22.XII.2016, R. Feitosa, W. Franco, P. Andrade cols. [DZUP]; seven ♀: Brazil: PR, Palmas, R.V.S.C.P. Transecto 2, 26°30'11.05"S 51°40'33.98"W, 19-22.XII.2016, R. Feitosa, W. Franco, P. Andrade cols. [DZUP]; one ♂ and 24 ♀: Brazil: PR, Ponta Grossa, P.E. Vila Velha – Campo Limpo, 25°14'52.74"S 49°59'5.01"W, 19-22.XII.2016, R.M. Feitosa, W. Franco, A.C. Neundorf, Y.S. Moreira cols. [DZUP]; 27 ♀: Brazil: PR, Ponta Grossa, P.E. Vila Velha – Campo Sujo, 25°14'37.85"S 50°00'44.05"W, 19-22.XII.2016, R.M. Feitosa, W. Franco, A.C. Neundorf, Y.S. Moreira cols. [DZUP].

**Geographic range.** Brazil: Paraná and Santa Catarina.

**Measurements, major worker:** EL: 0.20; FL: 0.84; HL: 1.15; HW: 1.13; IHP: 0.38; ML: 1.03; OHP: 0.48; PeL: 0.44; PeW: 0.22; PpL: 0.21; PpW: 0.32; PsL: 0.10; SL: 0.88; CI: 98; SI: 78; HPI: 79 (n = 1).

**Major worker. Head:** head side, in dorsal view, broadly convex, with dense appressed setae; head dorsal profile forming a broadly, continuous convexity, and vertexal margin shallowly emarginate. Hypostoma with median tooth vestigial; inner teeth distinct, narrow and slightly curved, converging apically, and widely spaced. Median clypeal carina absent; clypeal disc smooth. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, surpassing midheight between eye and vertexal margin but not reaching the margin, with appressed setae. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally, and with a reticulate-rugose patch. Space between frontal carinae longitudinally rugulose, with interspaces finely areolate. Vertexal surface, in frontal

view, smooth. **Mesosoma:** pronotum dorsally strongly areolate with a reticulate-rugose area anteriorly, and promesonotal dorsum, in lateral view, presenting sparse appressed setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum. **Metasoma:** petiolar peduncle, in profile, with dorsal margin narrowly concave, and petiolar node, in lateral view, broad and apically rounded. Postpetiole, in dorsal view, as wide as long and trapezoidal, and dorsally presenting stiff standing setae, two longer than the adjacent, and two shorter and appressed. First gastral tergum smooth; dorsally with a combination of stiff standing and appressed setae, no more than 1.5× the eye length. Color reddish-brown.

**Measurements, minor worker:** EL: 0.14; FL: 0.52 – 0.63; HL: 0.62 – 0.70; HW: 0.54 – 0.62; ML: 0.70 – 0.82; PeL: .29 – 0.33; PeW: 0.08 – 0.10; PpL: 0.13 – 0.14; PpW: 0.116 – 0.19; PsL: 0.05 – 0.06; SL: 0.62 – 0.78; CI: 87 – 89; SI: 115 – 126 (n = 3).

**Minor worker. Head:** vertexal margin, in dorsal view, emarginate and rounded; occipital carina, in dorsal view, not visible; postgenal bridge, in lateral view, areolate. Anterior clypeal margin emarginate; clypeal disc overlain with several rugulae with interspaces areolate. Space between eye and frontal carina strongly areolate, with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae strongly areolate with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface strongly areolate. **Mesosoma:** pronotal surface strongly areolate, dorsally with a reticulate-rugose patch anteriorly, and promesonotal dorsum, in lateral view, presenting sparse appressed setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection triangular; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, with smoothly rounded side, dorsally smooth, and presenting a combination of a pair of stiff standing setae, with shorter and appressed setae. First gastral tergum smooth; dorsally with a combination of stiff standing and appressed setae, no more than 1.5× the eye length. Color reddish-brown.

**Comments.** Similar species are *P. geraesensis* Santschi and *P. triconstricta* Forel. Majors of *P. paranana* have the vertexal lobe smooth and the anterior surface of head strongly sculptured with an areolate-rugose patch between eye and frontal carina; and pronotal dorsum areolate with a reticulate-rugose patch anteriorly; *P. geraesensis* has the head almost entirely smooth; and *P. triconstricta* has the pronotal dorsum uniformly areolate throughout its distribution in Brazil (Mato Grosso do Sul, Minas Gerais, Paraná, Pernambuco, Rio Grande do Sul, Santa Catarina, São Paulo).

Minors of *P. paranana* have the clypeal disc overlain with several rugulae with interspaces areolate; *P. geraesensis* has the surface strongly areolate while in *P. triconstricta* this surface is smooth. This same key character occurs in sympatric populations of *P. paranana* and *P. triconstricta* in the state of Paraná (see Franco & Feitosa (2018) for the records).

This species was first described as a variety of *P. triconstricta* by Santschi (1925). The author described *P. paranana* in comparison with *P. rosariensis* Forel based on the denser head sculpture in *P. paranana*. The sculpture on the pronotal surface can also readily differentiate these species, while *P. paranana* has the dorsum reticulate rugose, *P. rosariensis* has the dorsum areolate. Wilson (2003) synonymized *P. paranana* under *P. radoszkowskii*, without further justification. The head sculpture morphologically distinct in both species, with



**Figure 9** *Pheidole paranana* rev. stat. et n. stat. Major worker, syntype, CASENT0913465: (A) full-face view (B) lateral view (C) dorsal view. Minor worker, syntype, CASENT0913466: (D) full-face view (E) profile view (F) dorsal view. Image font: AntWeb.org; photographer: Will Ericson.

*P. radoszkowskii* head being densely sculptured and opaque, whereas the fronto-vertexal surface of the head is smooth in *P. paranana*. We revive *P. paranana* to species.

*Pheidole strobili* rev. stat.

(Figs. 10, 12)

*Pheidole strobili* Emery, 1906: 149 (major and minor worker). Goñi, Zolessi & Imai, 1983: 365 (karyotype). Lectotype major (CASENTO904388; here designated) and paralectotype minor (CASENTO904389; here designated) worker. Argentina: Misiones, Posadas. [MSNG] (image examined). Santschi, 1912: 528; Bruch: 1915: 531: subspecies of *P. cordiceps*. Emery, 1922: 101; Borgmeier, 1927: 61: status as species. Santschi, 1929: 282; Kempf, 1972: 197: subspecies of *P. nitidula*. Wilson, 2003: 328: as junior synonym of *P. nitidula*.

*Pheidole rufipilis divexa* Forel, 1908: 372 (major worker, minor and queen). Lectotype major (CASENTO908118; here designated) and paralectotype minor (CASENTO908203; here designated) worker. Brazil: São Paulo. [MHNG] (image examined). Wilson, 2003: 226: as junior synonym of *P. rufipilis*. **New synonym.**

*Pheidole nitidula daguerrei* Santschi, 1931: 275 (major and minor worker). Lectotype major (CASENTO913358; here designated) and paralectotype minor (CASENTO913359; here designated) worker. Argentina: Buenos Aires, Rosas. [NHMB] (image examined). Wilson, 2003: 328: as junior synonym of *P. nitidula*. **New synonym.**

*Pheidole perversa* Forel, 1908: 373 (major and minor worker). Lectotype major (CASENTO908152) worker and paralectotype minor (CASENTO908153) worker. Brazil: Rio Grande do Sul. [MHNG] (image examined). Emery, 1922: 101: subspecies of *P. strobili*. Kempf, 1972: 197: subspecies of *P. nitidula*. Wilson, 2003: 328: as junior synonym of *P. nitidula*. **New synonym.**

*Pheidole perversa richteri* Forel, 1909: 266 (major and minor worker, and queen). Lectotype major (CASENTO908150; here designated) and paralectotype minor (CASENTO908151; here designated) worker. Argentina, Buenos Aires [MHNG] (image examined). Santschi, 1916: 373: subspecies of *P. strobili*. Santschi, 1929: 281: subspecies of *P. nitidula*. Wilson, 2003: 328: junior synonym of *P. nitidula*. **New synonym.**

*Pheidole strobili misera* Santschi, 1916: 373 (major worker, minor and queen). Argentina. [probably NHMB] (not examined). Santschi, 1929: 282: as junior synonym of *P. strobili*. Wilson, 2003: 328: as junior synonym of *P. nitidula*. **New synonym.**

**Additional material:** 10 ♀: Brazil: PR, Palmas, R.V.S.C.P. Transecto 1, 26°30'30"S 51°40'8.12"W, 19-22.XII.2016, R. Feitosa, W. Franco, P. Andrade cols. [DZUP]; 19 ♀ and 74 ♂: Brazil: PR, Palmas, R.V.S.C.P. Transecto 2, 26°30'11.05"S 51°40'33.98"W, 19-22.XII.2016, R. Feitosa, W. Franco, P. Andrade cols. [DZUP]; nine ♀: Brazil: PR, Palmas, R.V.S.C.P. Transecto 3, 26°30'38.57"S 51°40'22.40"W, 19-22.XII.2016, R. Feitosa, W. Franco, P. Andrade cols. [DZUP]; one ♀: Brazil: PR, Ponta Grossa, P.E. Vila Velha – Campo Sujo, 25°14'37.85"S 50°00'44.05"W, 19-22.XII.2016, R.M. Feitosa, W. Franco, A.C. Neundorf, Y.S. Moreira cols. [DZUP].

**Geographic range.** Argentina: Alta Gracia, Buenos Aires, La Plata, and Misiones; and Brazil: Paraná, São Paulo, and Rio Grande do Sul.

**Measurements, major worker:** EL: 0.17 – 0.20; FL: 0.84 – 0.96; HL: 1.13 – 1.19; HW: 1.09 – 1.16; IHP: 0.33 – 0.37; ML: 1.08 – 1.13; OHP: 0.49 – 0.59, PeL: 0.42 – 0.43; PeW: 0.14 – 0.16; PpL: 0.18 – 0.21; PpW:



**Figure 10** *Pheidole strobili* rev. stat. Major worker, syntype, CASENTO904388: (A) full-face view (B) lateral view (C) dorsal view. Minor worker, syntype, CASENTO904389: (D) full-face view (E) profile view (F) dorsal view. Image font: AntWeb.org; photographer: Zach Lieberman.

0.24 – 0.25; PsL: 0.08 – 0.10; SL: 0.81 – 0.84; CI: 97; SI: 73 – 74; HPI: 57 – 74 (n = 3).

**Major worker. Head:** head side, in dorsal view, broadly convex, with appressed setae except in the vertexal margin with few standing setae; head dorsal profile forming a broadly, continuous convexity, and vertexal margin shallowly emarginate. Hypostoma with median tooth distinct; inner teeth distinct, narrow and straight, widely spaced. Median clypeal carina absent; clypeal disc smooth. Frontal lobe, in lateral view, projected and rounded. Scape, in frontal view, surpassing midheight between eye and vertexal margin but not reaching the margin, with a combination of appressed setae and standing. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally, and with a reticulate-rugose patch. Space between frontal carinae smooth with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface, in frontal view, smooth with few piligerous punctures. **Mesosoma:** pronotum dorsally smooth, anteriorly with transverse, straight to slightly curved rugulae, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum. **Metasoma:** petiolar peduncle, in profile, with dorsal margin broadly concave, and petiolar node, in lateral view, broad and apically rounded. Postpetiole, in dorsal view, as wide as long and trapezoidal, and dorsally presenting flexuous standing setae. First gastral tergum smooth; dorsally with flexuous standing setae, no more than 1.5× the eye length. Color light yellowish-brown.

**Measurements, minor worker:** EL: 0.16; FL: 0.63 – 0.65; HL: 0.66 – 0.70; HW: 0.56 – 0.60; ML: 0.78 – 0.80; PeL: 0.30 – 0.31; PeW: 0.08 – 0.10; PpL: 0.14 – 0.15; PpW: 0.16 – 0.17; PsL: 0.04 – 0.06; SL: 0.72 – 0.74; CI: 85 – 86; SI: 123 – 129 (n = 3).

**Minor worker. Head:** vertexal margin, in dorsal view, not emarginate and strongly rounded; occipital carina, in dorsal view,

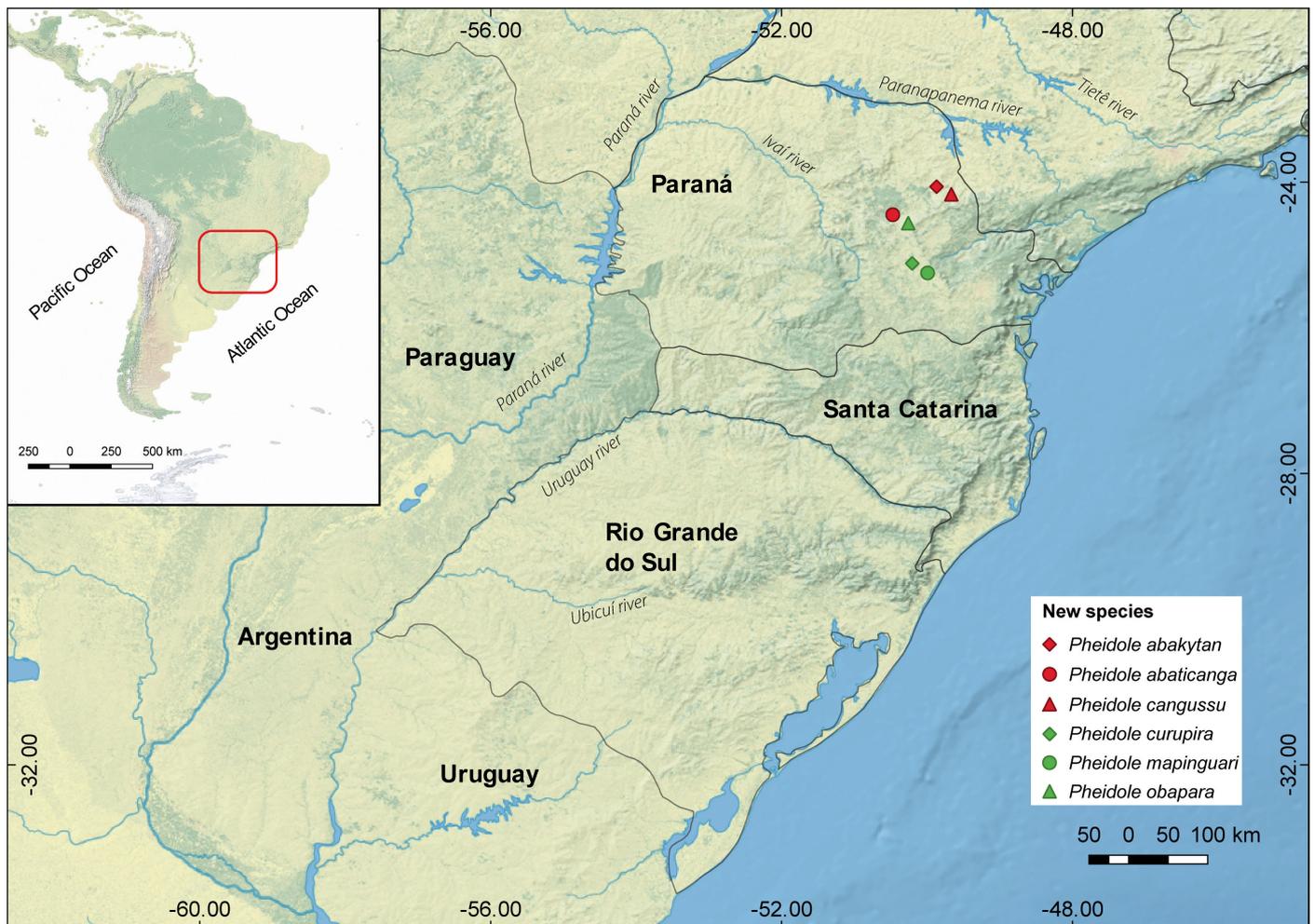
visible; postgenal bridge, in lateral view, smooth. Anterior clypeal margin not emarginate; clypeal disc smooth. Space between eye and frontal carina with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae smooth with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface smooth. **Mesosoma:** pronotal surface smooth, dorsally with few transverse, straight to slightly curved rugulae anteriorly, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile sinuous, with an anterior concavity and a distinctly produced median area. Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum; and propodeal dorsum finely to strongly areolate. **Metasoma:** postpetiole, in dorsal view, trapezoidal, dorsally smooth, and presenting flexuous standing setae. First gastral tergum smooth; dorsally with flexuous standing setae, no more than 1.5× the eye length. Color light yellowish-brown.

**Comments.** *Pheidole strobili* resembles *Pheidole nitidula* Emery and *Pheidole dione* Forel. Majors of *P. strobili* have the lateral margin of head with appressed hairs except in the vertexal margin with standing hairs, while *P. dione* has standing hairs that extend laterally, and *P. nitidula* has appressed hairs only. Minors of *P. strobili* have the vertexal margin of the head strongly rounded, and mesosoma with stiff standing hairs; *P. nitidula* has the margin

slightly rounded; and *P. dione* has the mesosoma with flexuous standing hairs.

*Pheidole strobili* and *P. nitidula* occur sympatrically in the state of Paraná (see Franco & Feitosa (2018) for the records), presenting a diagnosis consistent with the described above. Regarding *P. dione*, only known from Corrientes and Jujuy in Argentina, it is not possible to confirm its sympatry with *P. strobili* in a local scale in Argentina, considering that *P. strobili* occurs in La Plata and Alta Gracia (Bruch, 1931) as well as Misiones and Buenos Aires (junior synonym distribution).

Based on the head shape and sculpture pattern, this species was considered a subspecies of *P. nitidula* by Santschi (1929). Later, Wilson (2003) synonymized all the subspecies described for *P. nitidula* under this name. *Pheidole strobili* can be recognized by the distinctly different head pilosity. We revive *P. strobili* to species with three of the former subspecies of *P. nitidula* as its junior synonyms (*Pheidole nitidula daguerrei* Santschi, 1931, *P. perversa* Forel, 1908, and *Pheidole perversa richteri* Forel, 1909). Forel (1908) described *Pheidole rufipilis divexa*, a name subsequently synonymized under *Pheidole rufipilis* by Wilson (2003). The head sculpture in *P. rufipilis* (reticulate-rugose extending from the frontal lobe) is notably different from that of *P. rufipilis divexa*, (only a few rugulae extending from the frontal lobe). We consider *P. rufipilis divexa* a junior synonym of *P. strobili* by the lack of any important morphological differences.



**Figure 11** Map of South Brazil showing the localities for the new *Pheidole* species described here.

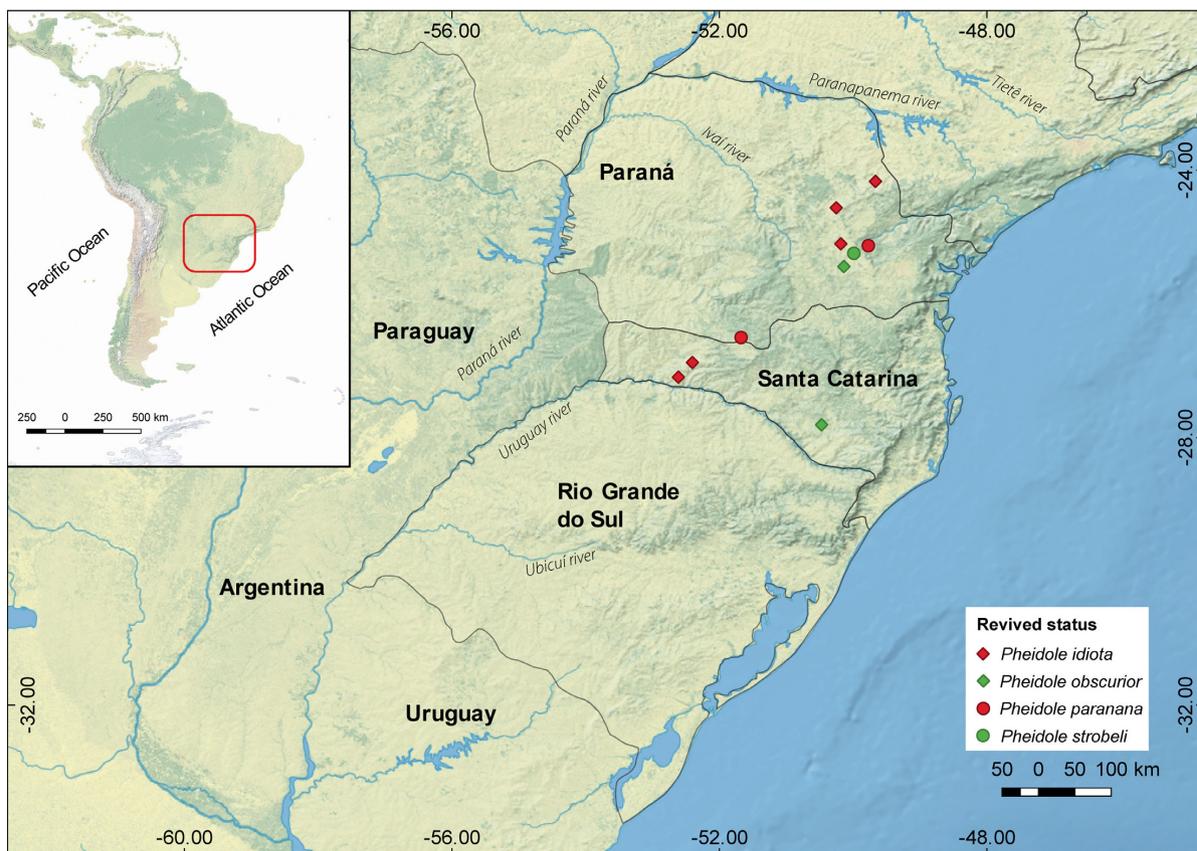


Figure 12 Map of South Brazil showing the localities for the *Pheidole* species revived here.

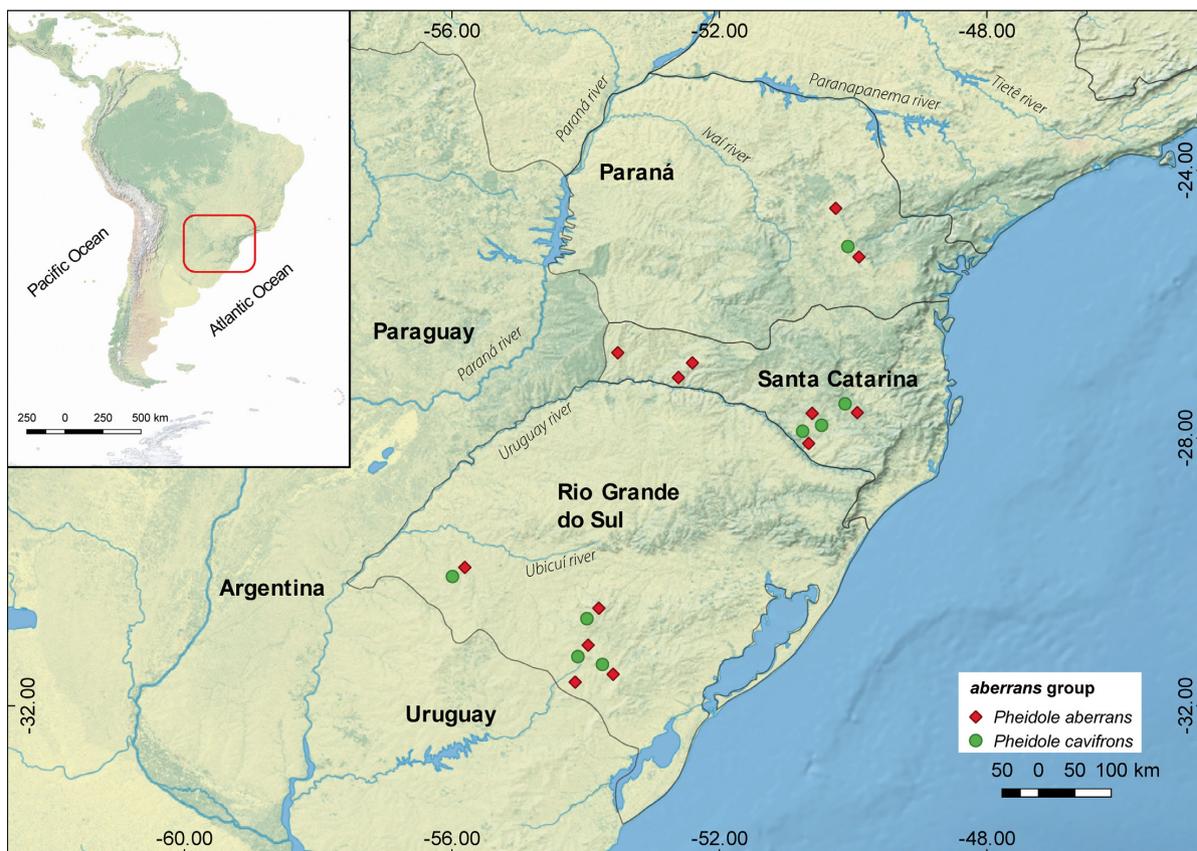


Figure 13 Map of South Brazil showing the localities for the *aberrans* group species records in grassland areas.

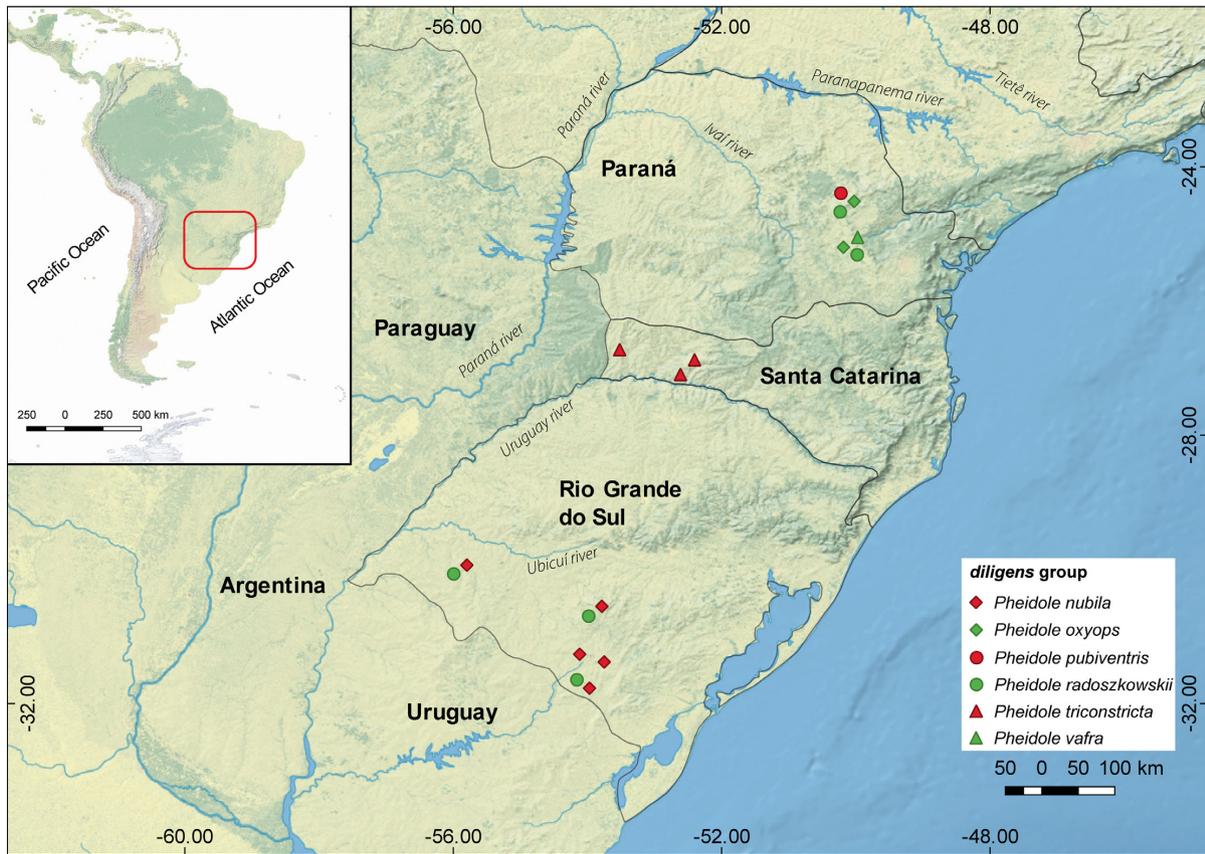


Figure 14 Map of South Brazil showing the localities for the *diligens* group species records in grassland areas.

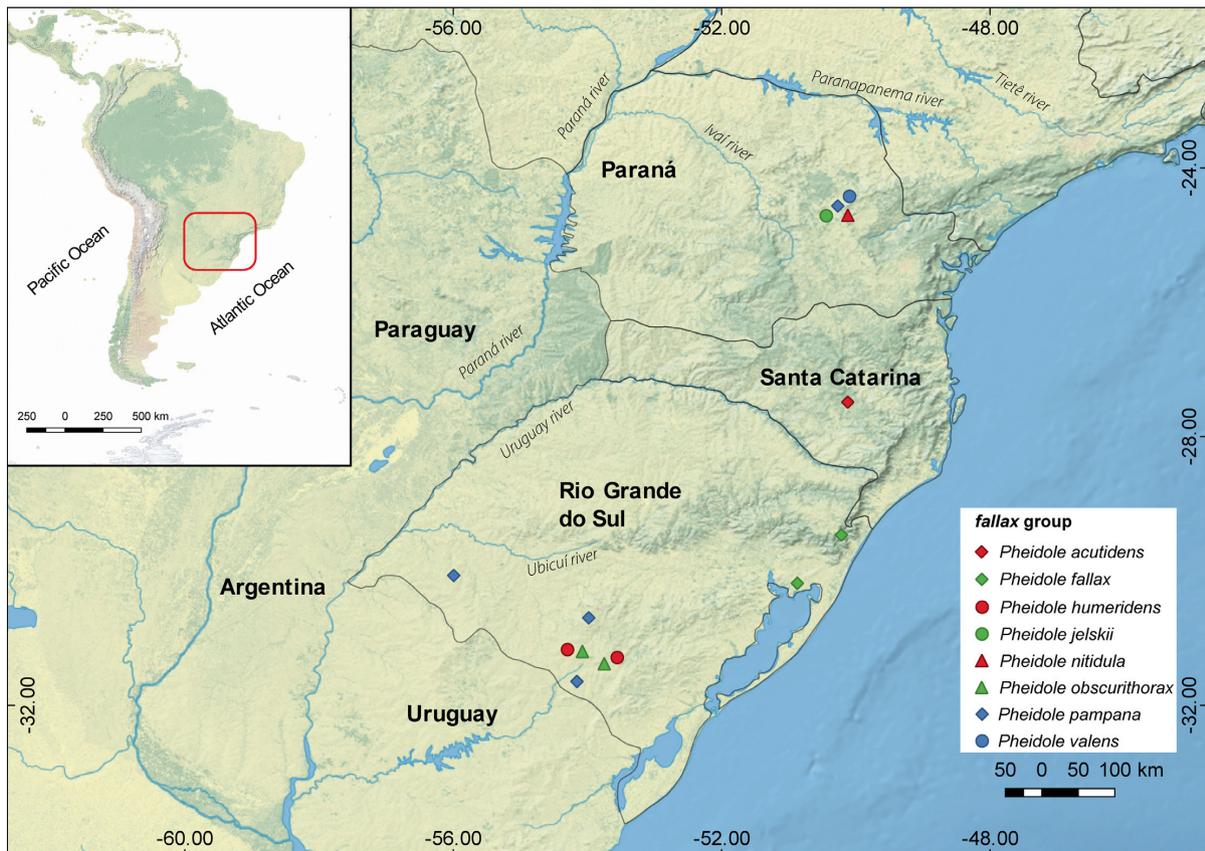


Figure 15 Map of South Brazil showing the localities for the *fallax* group species records in grassland areas.

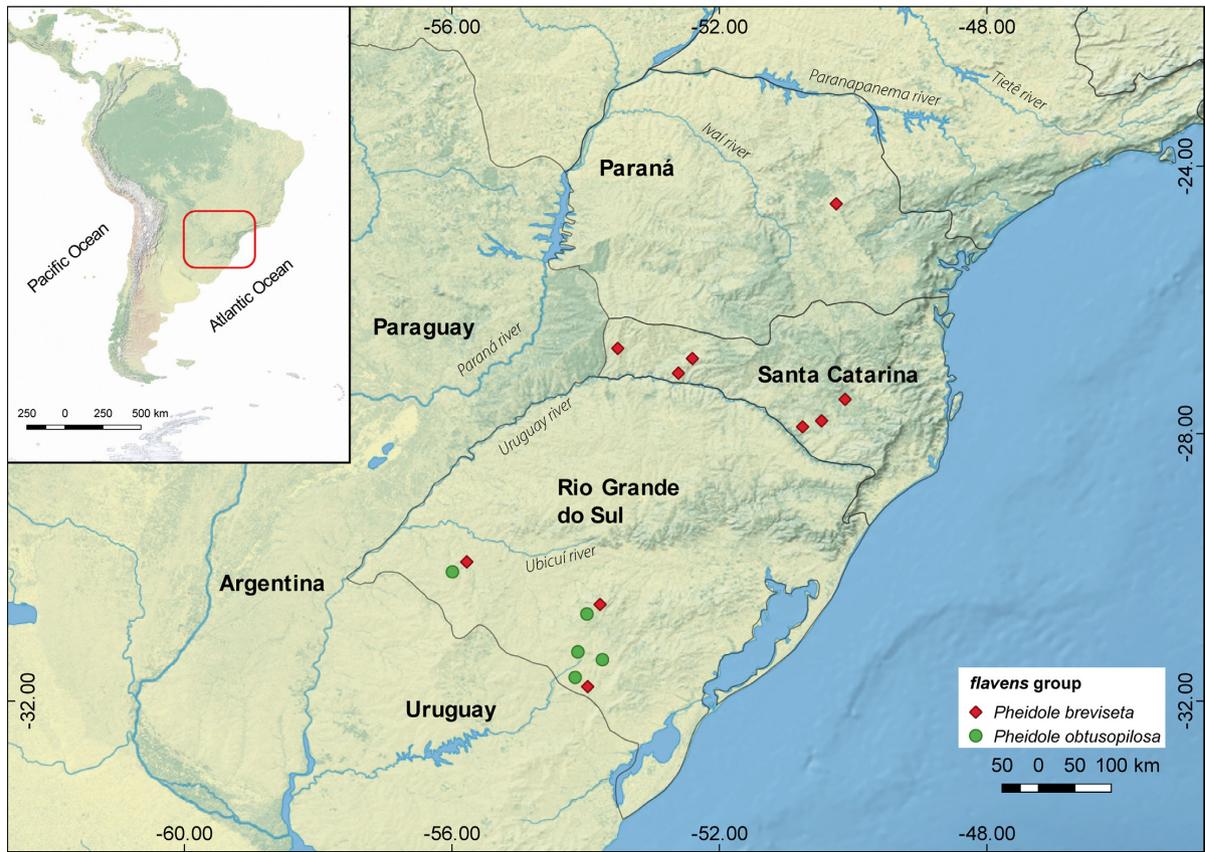


Figure 16 Map of South Brazil showing the localities for the *flavens* group species records in grassland areas.

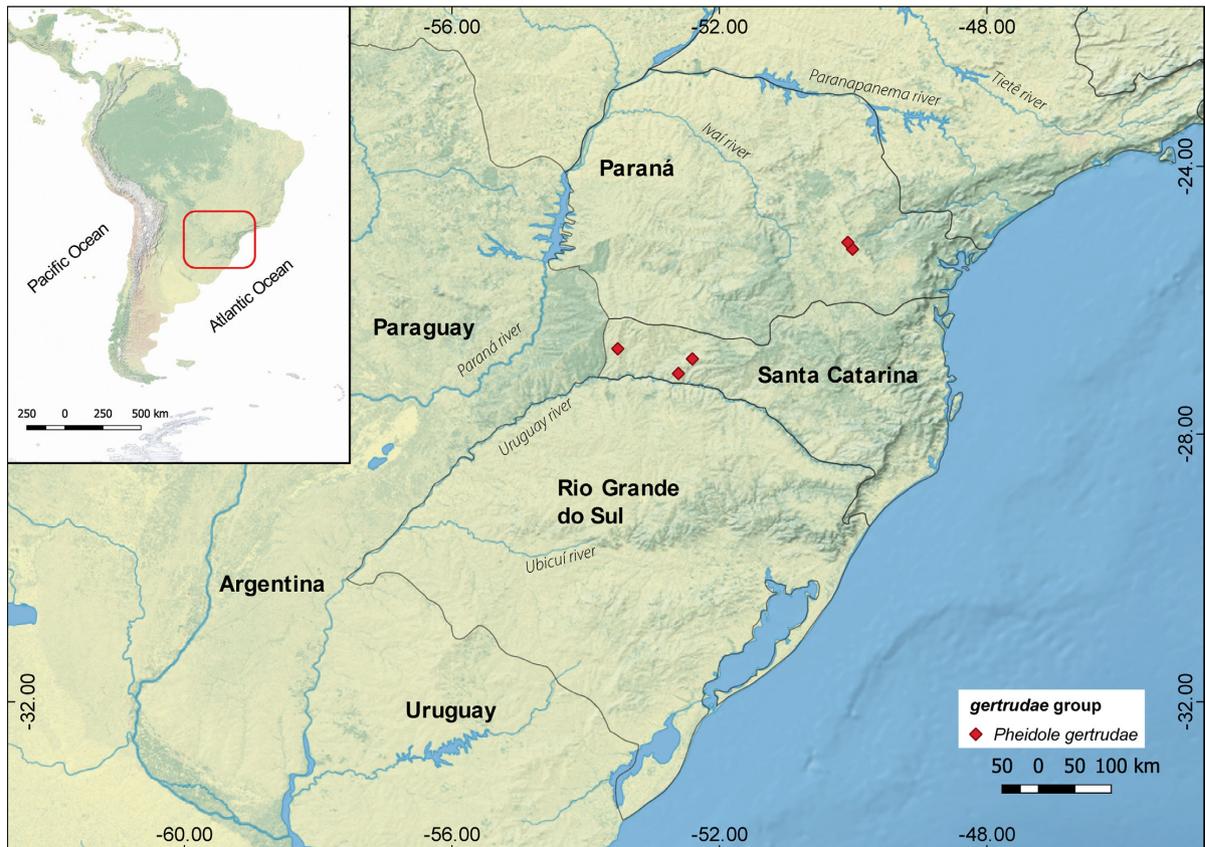


Figure 17 Map of South Brazil showing the localities for the *gertrudae* group species records in grassland areas.

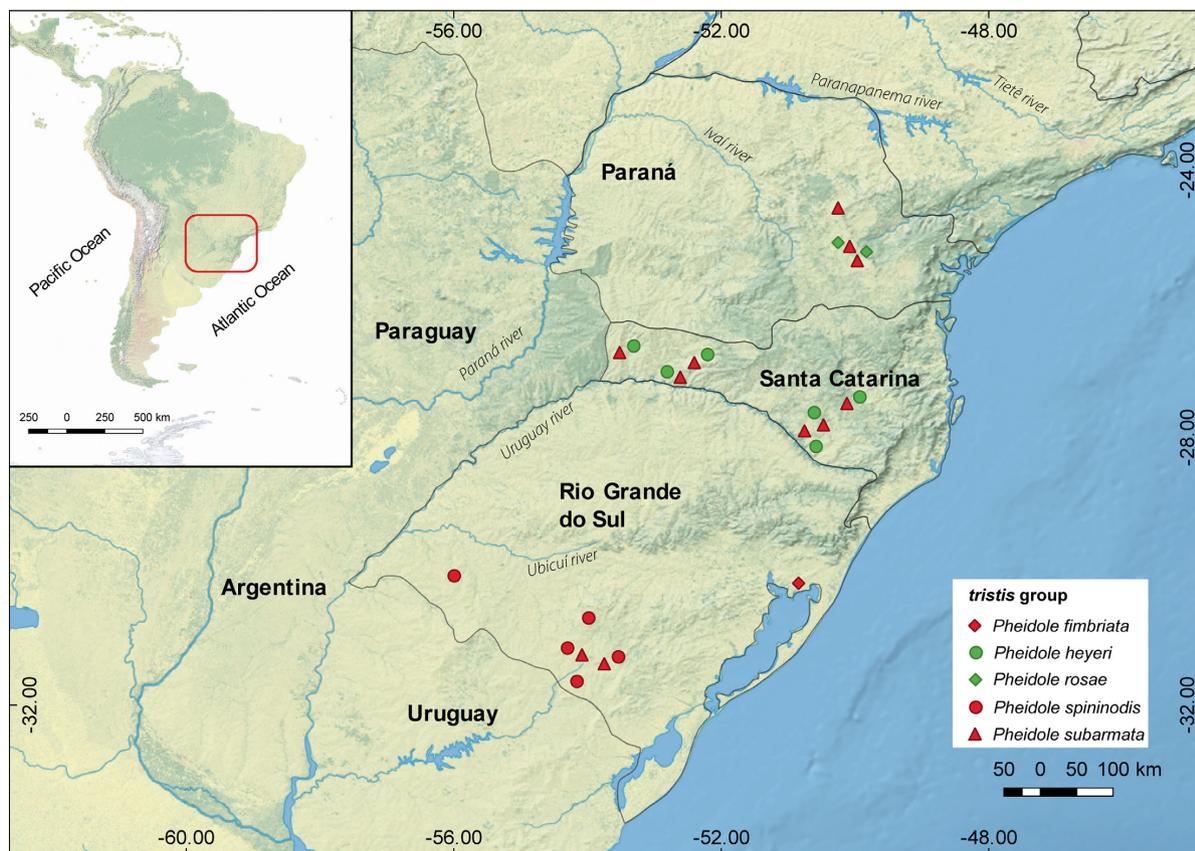


Figure 18 Map of South Brazil showing the localities for the *tristis* group species records in grassland areas.

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## Conflicts of interest

The authors declare no conflicts of interest.

## Author contribution statement

ACF, RMF conceived and designed the study; RMF funded and coordinated the field expeditions; RMF and EPE provided the facilities; ACF & RMF requested the specimens, and defined the format of external morphology descriptions and manuscript structure; EPE acquired the funds, access and expertise to the CT-scan; ACF described the ants, prepared the 3D scans, took the photos, stacked the images and made the distribution maps. All authors wrote the manuscript and approved the final version.

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