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. strobeli* 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. strobeli* (= *P. rutigills* diversa Forel n. syn., = *P. nitudula* daguerei Santschi n. syn., = *P. perversa* Forel n. syn., = *P. perversa* richteri Forel n. syn., = *P. strobeli* 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...
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 Mesoamerican fauna, a single Pheidole species was recently described from Bahia in Brazil (Pheidole protaxis 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 Cacaçu 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 epigaeric and hypogaeric 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 de 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/μCT 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 μm and 5.39 μm. 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 delimitated 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...
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; 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 anterioventral 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 × 100.
- **SI.** Scape index. SL/HW × 100.
- **HPI.** Hypostomal projections index. IHT/OHT × 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 &delta; and γ 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 Mourê de the Universidade Federal do Paraná, Curitiba, Brazil.
- **MCZC** Museum of Comparative Zoology, Cambridge, MA, USA.
- **MNHN** 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. CASENT0764125). 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 fortilla* Forel, 1913
- *Pheidole aberrans mutica* Emery, 1906
*Pheidole cavifronts* Emery, 1906
- *Pheidole arciruga* Forel, 1908
- *Pheidole cavifronts fuscipunctis* Santschi, 1916

**diligens group**

*Pheidole abakytan* **new species**

*Pheidole idiota* Santschi, 1923 **revived status**
- *Pheidole laticornis* Wilson, 2003 **new synonym**
- *Pheidole vafrä 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 vafrä 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 fallaciors* 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

**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 loretensis* Santschi, 1933
- *Pheidole humilis* (Borgmeier, 1930)

**transversostriata group**

*Pheidole obapara* **new species**

**tristis group**

*Pheidole cangussu* **new species**

*Pheidole curupirua* **new species**

*Pheidole fimбриata* Roger, 1863
- *Pheidole diversa* Smith, 1860
- *Pheidole fimбриata tucumana* Forel, 1913
- *Pheidole smithii* Dalla Torre, 1892
- *Pheidole soesilae* Makhan, 2007
*Pheidole heyeri* Forel, 1899
- *Pheidole guilelmimuelleri ulrix* Forel, 1912
*Pheidole rosae* Forel, 1901
- *Pheidole silvestri* Emery, 1906
*Pheidole spininodis* Mayr, 1887
- *Pheidole hohenlohei* Emery, 1888
- *Pheidole spiebbergi* Emery, 1888
- *Pheidole spininodis bruta* Santschi, 1934
- *Pheidole spininodis lucifuga* Santschi, 1923
- *Pheidole spininodis penceosensis* Forel, 1914
- *Pheidole spininodis solaris* Santschi, 1929
*Pheidole subarmata* Mayr, 1884
- *Pheidole cornutula* Emery, 1889
- *Pheidole cornutula dentimento* Santschi, 1929
- *Pheidole cornutula imbecilis* Emery, 1906
- *Pheidole hondurensis* Mann, 1922
- *Pheidole subarmata borerinquensis* Wheeler, 1908
- *Pheidole subarmata elongatula* Forel, 1893
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 paranae
          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 strobeli 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 vafrn

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 strobeli rev. stat.

Key to the species in the flavens group

4 Major: in side view, space immediately lateral to eye reticulate-rugose. Minor: posterior half of head reticulate-rugose ..................Pheidole verrucula
  – Major: in side view, space immediately lateral 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 transversosti 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 transversosti
  – 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 mesonotum convexity triangular, with an acute apex..............................................................16a
  – Major: in side view, profile of mesonotum 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 cangussus 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-F069754CA4C3 (Figs. 1, 11)

Holotype major worker: Brazil: PR, Jaguariaíva, Parque Estadual do Cerrado, 917m, 24°11'59"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); MSZP (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; HPI: 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. Space between frontal carinae finely areolate and standing setae. Propodeal projection spiniform, not as long as posterior face 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. Kepisternum 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:** prontum 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. Kepisternum 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 gastric 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 is the open woodlands.

**Etymology.** From Tupi-Guarani, Old Tupi, *āba* = hair, *kəytan* of *akytan* = short (de Carvalho, 1987), in apposition, referring to the hairs on the head of the major worker. The Old Tupi (also known as as *lingua 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/.

### *Pheidole abaticanga* n. sp.

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

**Holotype major worker:** Brazil: PR, Tabiã, P.E. do Guartelã, 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.
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 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 strongly areolate. Vertexal surface strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum.Katepisternum strongly areolate. Propodeal projection spiniform, not as long as posterior face of propodeum; and propodeal dorsum finely to strongly areolate. Mesosoma: pronotum surface strongly areolate, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile continuous, 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; and propodeal dorsum finely to strongly areolate.

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 gastric 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; PeL: 0.05; SL: 0.33; CI: 89 – 93; SI: 84 – 88 (n = 3).

Minor worker. Head: vertical 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 emarginate, with sparse concentric, and a few longitudinal rugulae laterally. Space between frontal carinae strongly areolate. Vertexal surface strongly areolate. Mesosoma: pronotum 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.

Etymology. From Tupi–Guarani, old Tupi (see details about the language at the description of P. abakytan above), abati=corn, canga of akânga=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.
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 vertical 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 vertical 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 smooth with few longitudinal rugulae extending posteriorly from frontal lobe. Vertical surface smooth. **Mesosoma:** pronotal surface finely areolate, laterally with a smooth posterior poster, 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.

**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. Vertical surface smooth. **Mesosoma:** pronotal surface finely areolate, laterally with a smooth posterior poster, 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. schwarzmairi* Borgmeier. Majo of *P. cangussu* have the mesosoma surface predominantly smooth, while *P. schwarzmairi* have the surface areolate. Mino of *P. cangussu* have the head smooth and mesosoma finely areolate; *P. schwarzmairi* have the head and mesonot distinctly areolate.

The type-series comes from pitfall traps installed at 804 m in the Parque Estadual do Cerrado, Jaguariaíva, 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 *akanga* = 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°14’52.74S 49°59’35.01W, 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 CASENT0472950); 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 vertical 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. Vertical surface, in frontal view, smooth. **Mesosoma:** pronotal surface finely areolate, anteriorly with transverse, straight to slightly curved rugulae, and promesonotal dorsum, in lateral view, presenting flexuous standing setae. Mesonotal profile

Figure 3 *Pheidole cangussu* 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]).
continuous, without a distinctly produced median area, and dropping almost vertically to the propodeum. Kätepisternum finely areolate with smooth median patch. Propodeal projection spiniform, not as long as propodeal projection vestigial; and produced median area, and gradually inclining to the propodeum. Spaces between frontal carinae smooth with few longitudinal rugulae. Vertexal surface smooth with few longitudinal rugulae laterally. Anterior clypeal margin emarginate and strongly rounded; occipital carina, in dorsal view, 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 paratype minor (CASENT091472; here designated) worker. Argentina: Córdoba, Alta Gracia. [NHMB] (image examined). Santschi, 1929: 284: subspecies of *P. vafr*a. Wilson, 2003: 244: as junior synonym of *P. vafr*a.

*Pheidole vafr*a **idiota** maculifrons**Santschi, 1929: 53 (major worker, minor and queen). Lectotype major (CASENT0913473; here designated) and paratype minor (CASENT091474; here designated) worker. Argentina: Córdoba, Alta Gracia [NHMB] (image examined). Brown, 1981: 526: as junior synonym of *P. vafr*a 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. vafr*a. New synonym.

**Additional material.** 12 ♀: Brazil: PR, Jaguariaíva, Parque Estadual do Cerrado, 804m, 24°10′35.7″S 49°39.59″W, 15.i.2015, A.M. Oliveira, R. Feitosa, J. Maravalhas, H. Vasconcelos cols. [DZUP]; three ♀: Brazil: PR, Jaguariaíva, Parque Estadual do Cerrado, 899m, 24°10′47.0″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′49.6″S 50°15′32.6″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′52.7″S 49°59′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′37.8″S 50°50′44.0″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, Transsect 1 (C. Pastetejo), 24°34′18.5″S 50°15′33.7″W, 20-25.IX.2015, W. Franco, R.M. Feitosa, A. Machado cols. [DZUP]; three ♀: Brazil: PR, Tibagi, P.E. do Guartelá, Transsect 3 (C. Alto), 24°33′47.8″S 50°15′14.29″W, 20-25.IX.2015, W. Franco, R.M. Feitosa, A. Machado col. [DZUP]; three ♀ 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.2011-12.2012, 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; Cl: 92 – 93; SI: 72 – 79; HPI: 67 – 77 (n = 3).

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; Cl: 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 mappinguari 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′52.74S 49°59′35.01W, 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) [Suppl 9 [online only]] and paratype, minor worker (CASENT0742948) [Suppl 10 [online only]], with label transcribed above.
Additional material: four ♂ and five ♀: Brazil: PR, Jaguaquirá, 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, Jaguaquirá, 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. Transsecto 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. Transsecto 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, Transsecto 1 (C. Pastejado), 24°34′30.50″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, Transsecto 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 ♂: 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°54′33″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; PHL: 0.42; ML: 1.08; PHL: 0.48; PL: 0.40; PW: 0.20; PPL: 0.23; PPN: 0.28; PLL: 0.13; SL: 0.84; SLS: 1.00; SSI: 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 apressed 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 gastric 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; PL: 0.28; PW: 0.12 – 0.13; PLL: 0.13 – 0.15; PPL: 0.15 – 0.16; SLS: 0.80; SL: 0.70 – 0.75; SLS: 86 – 92; SSI: 117 – 125 (n = 3).

Minor worker. Head: vertical 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: pronotum 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 gastric 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 phytophysiognomies, 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 gastric pilosity of major workers, with more than 1.5× the eye length.

Pheidole obapara n. sp.

urn:lsid:zoobank.org:act:E51B206A-3F7D-41C8-8295-462D02E0A500 (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 η; DZUP549914 and CASENT0790159); MCZC (1 η and 1 η; 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; CPI: 56 – 80 (n = 2).

Minor worker. Head: side head, 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 transversely posteriorly, with interspaces finely areolate. Antennal scrobe, in frontal view, shallow and areolate, delimited posteriorly by a curved rugulae. Vertical 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 distinctively 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; IHP: 0.58; ML: 0.20 – 0.22; PpL: 0.08; PeL: 0.10 – 0.12; PpW: 0.02; PsL: 0.02; 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. Vertical 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) oba = 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 susannae obscurior Forel, 1886: xlv (major and minor worker). Lectotype major (JTL000015316) and paralecotype 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. susannae.

Pheidole paritaa Mayr, 1887: 590 (major worker) 604 (minor worker). Lectotype major (CASENT0916067) worker and paralecotype minor (CASENT0917894) worker (here designated). Brazil: Rio de Janeiro. [NHMW] (image examined). Wilson, 2003: 330: as
junior synonym of *P. obscurior*. Longino, 2009: 79: as junior synonym of *P. susannae*. 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. susannae*. 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 ♂: Brazil: PR, Tibagi, P.E. do Guartelá, Transeco 3 (Cerrado), 24°33′47.86″S 50°15′14.29″W, 20–25.ix.2015, W. Franco, R.M. Feitosa, A.M. Machado cols. [DZUP]; two ♀: Brazil: SC, Lages, Planalto, 859m, Sta Gber. Do Salto, XII.2011–I.2012, 539441.7137 (UTM long) 6925116.989 (UTM lat), M.L.C. Bartetz 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; CI: 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. **Metasoma**: 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; PpL: 0.10 – 0.11; PpW: 0.14; PsL: 0.05; SL: 0.98 – 1.03; CI: 130 – 140; SI: 139 (n = 3).

**Minor worker. Head**: vertical 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. **Metasoma**: 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. susannae* 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. susannae* 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. susannae* were mainly related to the color pattern. Longino (2009) synonymized *P. obscurior* under *P. susannae* 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 revise *P. obscurior* to species with *P. partita* and *P. incisa evoluta* as its junior synonyms.

**Figure 8 Pheidole obscurior** rev. stat. Major worker, lectotype, JTLC0000015316: (A) full-face view (B) lateral view (C) dorsal view. Minor worker, paralectotype, JTLC000015317: (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. Transect 1, 26°30′S 51°40′12″W, 19–22.XII.2016, R. Feitosa, W. Franco, P. Andrade cols. [DZUP]; seven ♀: Brazil: PR, Palmas, R.V.S.C.P. Transect 2, 26°30′11″S 51°40′33″38″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 Limo, 25°14′52.74″S 49°59′50″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; SL: 78; HPI: 79 (n = 1).

Major worker. Head: head side, in dorsal view, broadly convex, with dense appressed setae; head dorsal profile forming a broad, 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. Mesonal 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: 0.29 – 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; Sl: 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 frontalis carinae strongly areolate with few longitudinal rugulae extending posteriorly from frontal lobe. Vertexal surface strongly areolate. Metasoma: pronotal surface strongly areolate, dorsally with a reticulate-rugose patch anteriorly, and promesonotal dorsum, in lateral view, presenting sparse appressed setae. Mesonal 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 pronoatal 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...
Pheidole strobeli rev. stat.

(Figs. 10, 12)

Pheidole strobeli Emery, 1906: 149 (major and minor worker). Goñi, Zolesii & Imai, 1983: 365 (karyotype). Lectotype major (CASENT0904388; here designated) and paralectotype minor (CASENT0904389; here designated) worker. Argentina: Misiones, Posadas. [MSN] (image examined). Emery, 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.

New synonym.

Pheidole perversa Forel, 1908: 372 (major worker, minor and queen). Lectotype major (CASENT0908118; here designated) and paralectotype minor (CASENT0908203; here designated) worker, Brazil: Rio Grande do Sul. [MHNG] (image examined). Emery, 1922: 101: subspecies of P. strobeli. 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 (CASENT0908150; here designated) and paralectotype minor (CASENT0908151; here designated) worker, Argentina, Buenos Aires [MHNG] (image examined). Santschi, 1916: 373: subspecies of P. strobeli. Santschi, 1929: 281: subspecies of P. nitidula Wilson, 2003: 328: junior synonym of P. nitidula. New synonym.

Pheidole strobeli misera Santschi, 1916: 373 (major worker, minor and queen). Argentina. [probably NHMB] (not examined). Santschi, 1929: 282: as junior synonym of P. strobeli. 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’’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; IH: 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: 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 midpoint 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 dorsal view, smooth with few piligerous punctures. Mesosoma: pronotum dorsally smoothly, 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 gastric 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 sinusuous, 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 strobeli* resembles *Pheidole nitidula* Emery and *Pheidole dione* Forel. Majors of *P. strobeli* 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. strobeli* 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 strobeli* 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. strobeli* in a local scale in Argentina, considering that *P. strobeli* occurs in La Plata and Alta Gracia (Bruch, 1931) as well as Missiones 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 strobeli* can be recognized by the distinctly different head pilosity. We revive *P. strobeli* 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. strobeli* by the lack of any important morphological differences.

![Figure 11 Map of South Brazil showing the localities for the new Pheidole species described here.](image-url)
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.
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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.

References

Albuquerque, E. Z. D., Diehl, E., 2009. Análise faunística das formigas epígeas (Hymenoptera, Formicidae) em campo nativo no Planalto das Araucárias, Rio Grande do Sul. Rev. Bras. Entomol. 53 (3), 398-403. https://doi.org/10.1590/S0085-562620090001400014.

Andrade, B. O., Bonilha, C. L., Ferreira, P. M. A., Boldrini, I. I., Overbeck, G. E., 2016. Highland grasslands at the Southern tip of the Atlantic Forest biome: management options and conservation challenges. Oecol. Aust. 20, 37-61. https://doi.org/10.4257/oeco.2016.2002.04.

AntWeb, 2020. AntWeb. Available from: https://www.antweb.org

Blender, 2019. Free & Open Source 3D Creation. Free to Use for any Purpose, Forever. Available from: https://www.blender.org (accessed 26 March 2020).

Boldrini, I. I., 2009. A flora dos campos do Rio Grande do Sul. In: Pillar, V.D.P., Müller, S.C., Castilhos, Z.M.C., Jacques, A.V.A. (Eds.), Campos Sulinos – Conservação e Uso Sustentável da Biodiversidade, Ministério do Meio Ambiente, Brasília, pp. 63-77.
Bolton, B., 2020. An Online Catalog of the Ants of the World. Available from: http://antcat.org (Accessed 22 September 2020)

Bruch, C., 1931. Notas biologicas y sistematicas acerca de Bruchomyrma acutidens. Revista Museo de La Plata. 33, 31-55.

Cignoni, P., Callieri, M., Corsini, M., Dellepiane, M., Ganovelli, F., Ranzuglia, G., 2008. Meshlab: an open-source mesh processing tool. In: Eurographics Italian Chapter Conference, 2008. Salerno, Italy. Proceedings. Geneve: The Eurographics Association, pp. 129–136.

de Carvalho, M. R., 1987. Dicionário Tupi (Antigo) Português. Empresa Gráfica da Bahia, Salvador, 324 pp.

de Moraes, T. F., Amorim, P. H., Azevedo, F. S., da Silva, J. V., 2011. InVesalius—An Open-source Imaging Application. Comput. Vis. Med. Image Process 405.

Diehl, E., Diehl-Fleig, E., Albuquerque, E. Z., Junqueira, L. K., 2014. Richness of termites and ants in the state of Rio Grande do Sul, Southern Brazil. Sociobiology 61, 145–154. https://doi.org/10.13102/sociobiology.v61i2.145-154.

Diehl, E., Saschart, F., Albuquerque, E. D., 2005. Riqueza de formigas de solo na praia da Pedreira, Parque Estadual de Itapuã, Viamão, RS, Brasil. Rev. Bras. Entomol. 49 (4), 552–556. https://doi.org/10.1590/S0085-56262005000400016.

Drüse, W., Podgaïski, R. L., Cavallieri, A., Feitosa, R. M., Mendonça Junior, M., 2017. Ground-dwelling and vegetation ant fauna in southern Brazilian Grasslands. Sociobiology 64 (4), 381–392. https://doi.org/10.13102/sociobiology.v64i2.145-154.

Dröse, W., Podgaïski, L. R., Dias, C. F., de Souza Mendonça Junior, M., 2019. Local and regional drivers of ant communities in forest-grassland ecotones in Southern Brazil: a taxonomic and phylogenetic approach. PLoS One 14 (4), e0215310. https://doi.org/10.1371/journal.pone.0215310.

Economou, E. P., Huang, J. P., Fischer, G., Sarnat, E. M., Janda, M., Narula, N., Guénard, B., Longino, J., Knowles, L. L., 2019. Evolution of the latitudinal diversity gradient in the hyperdiverse ant genus Pheidole. Glob. Ecol. Biogeogr. 28, 456–470. https://doi.org/10.1111/geb.12867.

Faulwetter, S., Dailianias, T., Vasileiadou, A., Arvanitidis, C., 2013. Contrast enhancing techniques for the application of micro-CT in marine enhancing techniques for the application of micro-CT in marine ecosystem. Divers. Distrib. 21 (12), 1455-1460. https://doi.org/10.1111/ddi.12380.

Fischer, G., Sarnat, E., Economou, E. P., 2016. Revision and microtomography of the Pheidole knowlesi group, an endemic ant radiation in Fiji (Hymenoptera, Formicidae, Myrmicinae). PLoS One 11, e0158544. https://doi.org/10.1371/journal.pone.0158544.

Forel, A., 1886. Espèces nouvelles de fourmis américaines. Ann. Soc. Entomologique Belg. 30, xxxviii–xliv.

Forel, A., 1908. Ameisen aus Sao Paulo (Brasilien), Paraguay etc. gesammelt von Prof. Herrn. v. Ihering, Dr. Lutz, Dr. Fiebrig, etc. Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien 58: 340–418.

Franco, W., Feitosa, R. M., 2018. First standardized inventory of ants (Hymenoptera: Formicidae) in the natural grasslands of Paraná: New records for Southern Brazil. Pap. Avulsos Zool. 58, https://doi.org/10.11606/1807-0205/2018.58.12.

Hita Garcia, F., Fischer, G., Liu, C., Audisio, T. L., Alpert, G. D., Fisher, B. L., Economou, E. P., 2017. X-Ray microtomography for ant taxonomy: an exploration and case study with two new Terataner (Hymenoptera, Formicidae, Myrmicinae) species from Madagascar. PLoS One 12, e0172641. https://doi.org/10.1371/journal.pone.0172641.

InVesalius, 2016. Open Source Software for Reconstruction of Computed Tomography and Magnetic Resonance Images. Available in: http://www.cti.gov.br/invesalius/?page_id=8 (accessed 26 March 2020).

Longino, J. T., 2009. Additions to the taxonomy of New World Pheidole (Hymenoptera: formicidae). Zootaxa 2181, 1–90. https://doi.org/10.11646/zootaxa.2181.1.1.

Longino, J. T., 2019. Pheidole (Hymenoptera, Formicidae) of Middle American Wet Forest. Zootaxa 4599 (1), 1–126. https://doi.org/10.11646/zootaxa.4599.1.1.

Maack, R., 1981. Geografia Fisica do Estado do Paraná. Livraria José Olympio, Rio de Janeiro, 442 p.

Martins, M. F. D. O., Thomazini, M. J., Baretta, D., Brown, G. G., Rosa, M. G. D., Zagatto, M. R. G., Santos, A., Nadolny, H. S., Cardoso, G. B. X., Niva, C. C., Bartz, M. L. C., Feitosa, R. M., 2020. Accessing the subterranean ant fauna (Hymenoptera: Formicidae) in native and modified subtropical landscapes in the Neotropics. Biota Neotrop. 20 (1), https://doi.org/10.1590/1676-0611-bn-2019-0782.

Melo, M. S., Moro, R. S., Guimarães, G. B., 2001. Os campos gerais do Paraná. In: Melo, M. S., Moro, R. S., Guimarães, G. B. (Eds.), Patrimônio Natural dos Campos Gerais do Paraná. UEPG, Ponta Grossa, pp. 18–22.

Oliveira, M. L., Mariano, C. S. F., Costa, M. A., Delabie, J. H. C., Lacau, S., 2015. Pheidole protax sp. nov. (Hymenoptera: Formicidae), new species from tabuleiro forests of the Atlantic Forest biome. Sociobiology 62 (4), 533–537. https://doi.org/10.13102/sociobiology.v62i4.866.

Overbeck, G. E., Müller, S. C., Fidelis, A., Pfadenhauer, J., Pillar, V. D., Blanco, C. C., Boldrini, I. L., Both, R., Fornek, E. D., 2007. Brazil’s neglected biome: the South Brazilian Campos. Perspect. Plant Ecol. Evol. Syst. 9, 101–116. https://doi.org/10.1016/j.ppees.2007.07.005.

Overbeck, G. E., Vélez-Martín, E., Scarno, F. R., Lewinsohn, T. M., Fonseca, C. R., Meyer, S. T., Müller, S. C., Ceotto, P., Dadalt, L., Durigan, G., Ganade, G., 2015. Conservation in Brazil needs to include non-forest ecosystems. Divers. Distrib. 21 (12), 1455–1460. https://doi.org/10.1111/ddi.12380.

Pinheiro, E. R., Duarte, L. D. S., Diehl, E., Hartz, S. M., 2010. Edge effects on epigeic ant assemblages in a grassland–forest mosaic in Southern Brazil. Acta Oecol. 36, 365–371. https://doi.org/10.1016/j.actao.2010.03.004.

Rosado, J., Gonçalves, M., Feitosa, R., Dröse, W., Krüger, R., Silva, E. E., Loeck, A., 2012. Epigeic ants (Hymenoptera: Formicidae) in vineyards and grassland areas in the Campanha region, state of Rio Grande do Sul, Brazil. Check List 8, 1184. https://doi.org/10.15566/8.6.1184.

Santschi, F., 1923. Pheidole and quelques autres fourmis néotropicaines. Ann. Soc. Entomologique Belg. 63, 45-69.

Santschi, F., 1925. Nouvelles fourmis brésiliennes. Ann. Soc. Entomologique Belg. 64, 5-20.

Santschi, F., 1929. Nouvelles fourmis de la République Argentine et du Brésil. An. Soc. Cient. Argent. 107, 273-316.

Sarnat, E. M., Fischer, G., Economou, E. P., 2016. Inordinate spinescence: taxonomic revision and microtomography of the Pheidole cervicornis species group (Hymenoptera, Formicidae). PLoS One 11 (7), e0156709. https://doi.org/10.1371/journal.pone.0156709.

Wilson, E. O., 1955. A monographic revision of the ant genus Lasius. Bull. Mus. Comp. Zool. 113, 1-201.

Wilson, E. O., 2003. Pheidole in the New World: a Dominant, Hyperdiverse Ant Genus (Vol. 1). Harvard University Press, Cambridge, 818 pp.