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## **Additions to the taxonomy of New World *Pheidole* (Hymenoptera: Formicidae)**

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## Abstract

The hyperdiverse ant genus *Pheidole* has its center of diversity in the New World, where over 600 species occur. In spite of recent revisionary work (Wilson 2003) new species continue to be discovered and understanding of geographic variation of named species continues to improve. In this report new species and taxonomic changes are proposed for the Central American fauna. The following new species are described: *P. bigote*, *P. branstetteri*, *P. carinote*, *P. debilis*, *P. eowilsoni*, *P. epiphyta*, *P. fossimandibula*, *P. gymnoceras*, *P. janzeni*, *P. karolmorae*, *P. karolsetosa*, *P. lagunculinoda*, *P. leoncortesi*, *P. mesomontana*, *P. pararugiceps*, *P. phanigaster*, *P. picobarva*, *P. purpurea*, *P. rhinomontana*, *P. sebofila*, *P. sparsisculpta*, *P. synanthropica*, and *P. tenuicephala*. The following new synonymy is proposed, with the senior synonym listed first and the junior synonym(s) in parentheses: *P. angusticeps* Wilson (= *P. gradifera* Wilson); *P. arachnion* Wilson (= *P. iracunda* Wilson); *P. bilimeki* Mayr (= *P. rectiluma* Wilson); *P. boliviana* Wilson (= *P. mincana* Wilson, *P. scitula* Wilson); *P. boltoni* Wilson (= *P. humida* Wilson); *P. deceptrix* Forel (= *P. chiapasana* Wilson, *P. variceps* Wilson); *P. erratilis* Wilson (= *P. petersoni* Wilson); *P. exarata* Emery (= *P. grantae* Forel); *P. harrisonfordi* Wilson (= *P. prolixa* Wilson, *P. ruida* Wilson, *P. tenebra* Wilson); *P. laselva* Wilson (= *P. ebenina* Wilson); *P. mooreorum* Wilson (= *P. fariasana* Wilson); *P. nebulosa* Wilson (= *P. scabriventris* Wilson); *P. nitidicollis* Emery (= *P. sagana* Wheeler); *P. perpusilla* Emery (= *P. breviscapa* Forel); *P. pubiventris* Mayr (= *P. variegata* Emery, *P. indistincta* Forel); *P. radoszkowskii* Mayr (= *P. medialis* Wilson); *P. sculptior* Forel (= *P. tayrona* Wilson); *P. susannae* Forel (= *P. obscurior* Forel and its synonym *P. partita* Mayr); *P. texticeps* Wilson (= *P. perdiligens* Wilson); *P. vorax* (Fabricius) (= *P. cephalica* F. Smith and its synonyms *P. opaca* Mayr, *P. incrustata* Forel, *P. sarrita* Forel, *P. apterostigmoides* Weber); *P. walkeri* Mann (= *P. arietans* Wilson, *P. glyphoderma* Wilson, *P. triumbonata* Wilson). *Pheidole innupta* Menozzi is removed from synonymy under *P. alfaroi* and revalidated.

**Key words:** biodiversity, Central America, Myrmicinae, hyperdiversity

## Introduction

Westwood (1839) chose the Greek *pheidolos*, thrifty (Wheeler and Wheeler 1984), as the root of his genus *Pheidole*, but in terms of species richness there is nothing thrifty about this ant. With 1124 valid names it is now the largest ant genus and among the largest genera of life in general. Over two thirds of this diversity occurs in the New World, and molecular evidence supports a New World origin (Moreau 2008). Wilson (2003) aptly described the group as "hyperdiverse," and it has the potential to contribute to the study of adaptive radiations (Gavrilets and Losos 2009), macroecology, biogeography, and biotic response to climate change (e.g. Colwell et al. 2008).

*Pheidole* taxonomy has developed episodically as a series of regional works. By far the most ambitious work on the genus was Wilson's 2003 monograph on the species of the New World, in which the entire New World fauna, 624 species, was reviewed and illustrated. Taxonomic works subsequent to Wilson's revision include two new species from Guyana (LaPolla and Cover 2005, LaPolla 2006), a species from India (Bharti 2004), a series of works on the Asian fauna (Eguchi 2004, 2006, 2008; Eguchi and Bui 2005; Eguchi et al. 2007), and a revision of the *P. roosevelti* group of Fiji (Sarnat 2008).

Wilson's monograph on the New World fauna has had a galvanizing effect, inspiring renewed interest in the genus by myrmecologists (e.g., the *Pheidole* working group, [academic.evergreen.edu/projects/ants/pheidoleworkinggroup/](http://academic.evergreen.edu/projects/ants/pheidoleworkinggroup/)). However, if we adopt a cartographic metaphor for taxonomy (O'Hara 1993) and view it as biodiversity mapping rather than discovering essentialistic entities (typological species), the task is not one of completing the taxonomy, but rather continually refining it. Just as there is no single true geographic map, there can be no final word in *Pheidole* taxonomy. There is still a great deal of refining to be done, both in terms of discovery of new species and greater understanding of geographic variation in named species. Progress will be made through three activities: DNA sequencing, analysis of morphology, and additional field collecting. DNA sequencing is essential at the two ends of the phylogenetic spectrum: the phylogenetic "backbone" of the genus that reveals species groups and their relationships (e.g., Moreau 2008), and cryptic species at the ends of the phylogenetic branches. There remains a broad middle region where characterization of external morphology is still a productive approach to delimiting and identifying species.

Wilson's revision emphasized certain geographic regions where abundant collecting had taken place in the context of both taxonomic collecting and ecological sampling. In Central America, hotspots were La Selva Biological Station in Costa Rica and Barro Colorado Island in Panama. Species knowledge is sparse elsewhere in Central America. Since the revision, three projects have greatly increased the specimen base and expanded the geographic coverage in Central America: ALAS IV, TEAM, and LLAMA. Project ALAS (Arthropods of La Selva) was a long-term, large-scale inventory of arthropods at La Selva, and a fourth phase of the project sampled along an elevational transect, known as the Barva Transect, that extends from La Selva to the peak of Volcan Barva. The Barva transect is a continuously forested area of protected land that is 35km long and rises from 50m elevation at La Selva to 2600m elevation at its upper end. The TEAM project (Tropical Ecological Assessment and Monitoring) was initiated and funded by Conservation International to establish biodiversity baseline data. For three years it included regular quantitative sampling of leaf litter ants from the lower portion of the Barva transect. Project LLAMA (Leaf Litter Arthropods of MesoAmerica) is an on-going project that has as its objective a broad program of litter arthropod sampling from southern Mexico to Nicaragua, complementing the earlier extensive work in Costa Rica. In 2008 LLAMA completed sampling at nine sites in Chiapas, Mexico. All these projects have contributed greatly to our understanding of *Pheidole* species. New species have been discovered and many species that were previously known only from type series are now known from many collections and many localities. Ecological studies and studies of biotic response to climate change depend on sound taxonomy and species concepts, providing a pressing impetus for regular taxonomic updates for *Pheidole*.

Identifying species in a genus with over 1000 species is not easy. *Pheidole* species are scattered across morphology space in a way that makes construction of traditional dichotomous keys difficult, and use of existing keys is a maddening experience. However, matrix keys that allow one to locate neighboring species

in morphology space can be remarkably effective. The *Pheidole* Working Group (<http://academic.evergreen.edu/projects/ants/pheidoleworkinggroup>) has developed a Lucid key to New World *Pheidole* as an identification tool, with the anticipation that it will be continually updated and corrected. It has a limited set of characters that are not designed to identify every species but instead to narrow the search, after which other resources such as species descriptions, web-based species pages, and image libraries can be consulted. The taxonomic update presented here does not contain keys or modifications of existing keys. It is assumed that users will make use of the *Pheidole* Working Group Lucid key, which will incorporate these changes. Diagnoses of new species similarly rely on the Lucid key to locate a set of morphometrically similar species, with the Diagnosis emphasizing differentiating characters within this group.

## Characters

A hallmark of the genus *Pheidole* is discrete major and minor workers. Each caste has distinctive characters that can aid in species separation. In some cases multiple species may have indistinguishable minor workers but distinctive major workers, and in other cases the reverse is true.

### Minor worker

**Occipital carina.** The occipital foramen is surrounded posteriorly and laterally by a differentiated cuticular rim: the occipital carina (Gauld and Bolton 1988) [in some Old World species the carina extends anteriorly as the genal carina]. In most species the occipital carina is not visible in full-face view. In some cases it is visible as a narrow rim. But in a few species it is highly developed as a flaring collar that encloses (and presumably protects) the articulation of the head and mesosoma. In these cases it is easily visible in face view. It is termed the "nuchal collar" in Wilson (2003).

**Sculpture.** Minor face sculpture is highly variable, in some cases intraspecifically, but there are two common patterns: completely smooth and shining, and uniformly foveolate (foveolae are small pits). Less often the face is rugose. Often faint rugulae may overlies foveolate sculpture. The side of the mesosoma may be uniformly foveolate, or there may be smooth shiny patches on the side of the pronotum, on the katepisternum, or both. These sculptural features may also be overlain with rugae of varying distribution and strength.

A common condition is for the first gastral tergum (fourth abdominal tergum) to be completely smooth and shining. In some species a portion of the tergum is sculptured, usually a shagreening (very fine granular microsculpture) that makes the surface dull instead of shining. The entire tergum may be sculptured, or some portion anteriorly, grading to smooth and shining posteriorly. The sculpture may be faint, requiring that the specimen be tilted at certain angles to see it. Also, one can be fooled by dirty specimens with surface films covering the gaster. For example, when specimens are collected with greasy baits like tuna or cookies they may acquire a grease layer that obscures surface sculpture.

**Pilosity** varies greatly among species and is an excellent character for species-level distinctions. Pilosity may be abundant or sparse, flexuous or stiff. The pilosity of the hind tibia (mid tibia often or always the same) often provides species-level characters. The tibia may appear completely bare, with very short, fully appressed pubescence and no erect setae. It may be densely clothed in short, subdecumbent to suberect pubescence that appears very uniform in length, and with no erect setae. It may have one of the above states of underlying pubescence, but in addition several long erect setae. It may be covered entirely with long erect setae, with no differentiation of long setae and underlying pubescence. It may have an underlying pubescence grading into suberect setae of varying length, so that it blurs the distinction among the previously described conditions. Tibial pilosity sometimes very clearly differentiates species that are otherwise difficult to tell apart.

## Major worker

**Hypostomal teeth.** The ventral surface of the head in ants is formed by the genal bridge. In major workers, the anterior margin of the genal bridge forms a nearly right angle, and a thin, shelf-like hypostomal sclerite extends inward to the buccal cavity. The juncture of the genal bridge and the hypostomal sclerite is the hypostomal margin. There is nearly always a pair of teeth at the inner margin of the hypostomal sclerite, bordering the bases of the mandibles. These are the **Outer Hypostomal Teeth**. Less regularly present are a pair of teeth on the hypostomal margin itself. When present, these teeth are always more closely spaced than the outer teeth, and are the **Inner Hypostomal Teeth**. There may also be a median tooth on the hypostomal margin. The median tooth, when present, often seems intraspecifically variable in size and distinctness.

**Scrobes** are depressions or grooves beneath the scapes. Some majors have evenly convex faces, with no hint of a scrobe. Many species have shallow scrobes, ranging from a barely discernable flattening beneath the scape to a conspicuous depression. Often the sculpture in a scrobe is weaker than the sculpture around it, to the extent of forming a smooth shiny patch surrounded by foveate or rugose sculpture. In some cases the scrobe is very strongly developed, forming a deep channel with distinct medial and lateral margins, such that the scape can be completely recessed and protected within it. Even in the absence of a scrobe, this region of the head is referred to as the scrobal area when describing the face sculpture.

**Scape.** The scape base may be terete (round in cross section) or strongly flattened, and it may be gently or strongly curved where it attaches to the head.

**Postpetiole.** The postpetiole in dorsal view assumes a variety of shapes. In some cases the sides are smoothly rounded, in some the shape is trapezoidal, and in others the sides are produced as acute, angular ("conulate") projections. These characters grade into each other and are partially captured by PPI (postpetiole index).

**Gastral sculpture** is like the minor workers. In many cases the first gastral tergum is completely smooth and shining. In others, part or all of the tergum is shagreened or foveolate. When partially sculptured, the sculpture is anterior, grading to smooth and shining posteriorly.

**Pilosity.** When in full-face view, the appearance of pilosity on the sides of the head is often of species-level diagnostic value. Some species show no projecting pilosity at all. Some have dense decumbent short or long pubescence. Some have abundant long or short erect setae. Tibial pilosity of major workers usually but not always parallels that of the minor workers. Pilosity on the metasomal dorsum is highly variable. Some species have the first gastral tergum entirely bare and with sparse, short, fully appressed pubescence. Others have dense long subdecumbent pubescence and no erect setae. The majority of species have erect setae of some form, either short and stiff or long and flexuous.

## Measurements

### *Minor and major workers*

- HL head length; in full-face view, maximum length of head, from line tangent to anteriormost projection of head capsule or clypeus to line tangent to posteriormost projection of vertex margin (including occipital carina, if visible).
- HLA anterior head length; in full-face view, distance between line tangent to anteriormost projection of head capsule or clypeus and line tangent to lowermost margin of compound eye.
- HW head width; in full-face view, maximum width of head capsule **not including eyes** (if eyes protrude beyond margins of head, measured above or below eyes, depending on which is widest).
- SL scape length; length of scape shaft from apex to basal flange, not including basal condyle and neck.
- EL eye length; maximum length of compound eye, with head oriented to maximize length (i.e., not full-face view).

|      |   |
|------|---|
| ML   | mesosoma length; in lateral view, distance from base of anterior face of pronotum (at inflection point between downward-sloping anterior face and flange-like anteriormost projection of pronotum [the latter extending to foramen and usually partially hidden by head capsule]) to posteriormost extension of metapleural or propodeal lobes (whichever extends further). |
| PSL  | propodeal spine length; viewed laterally such that side of spine is roughly perpendicular to viewing angle, distance from inflection point between dorsal face of propodeum and base of spine to tip of spine.  |
| PMG  | depth of promesonotal groove; measured by establishing a line tangent to dorsalmost convexities of pronotum and mesonotum, measuring perpendicular distance from this line to bottom of promesonotal groove.  |
| SPL  | propodeal spiracle width, measured from the outer edge of cuticular ring that surrounds orifice.  |
| PTW  | petiole width; maximum width of petiole in dorsal view.   |
| PPW  | postpetiole width; maximum width of postpetiole in dorsal view.   |
| CI   | cephalic index; $100 \cdot HW/HL$ .   |
| SI   | scape index; $100 \cdot SL/HW$ .  |
| PSLI | propodeal spine index; $100 \cdot PSL/HL$ .   |
| PMGI | Promesonotal groove index; $100 \cdot PMG/HL$ .   |
| SPLI | Propodeal spiracle index; $100 \cdot SPL/HL$ .  |
| PPI  | Postpetiole index; $100 \cdot PPW/PTW$ .  |

#### *Major workers only*

|     |   |
|-----|---|
| IHT | distance between inner hypostomal teeth.      |
| OHT | distance between outer hypostomal teeth.      |
| HTI | Hypostomal tooth index; $100 \cdot IHT/OHT$ . |

When hypostomal teeth are curved laterally (either inward or outward), the approximate midpoint of the base of the tooth is used, not the tip.

## **Methods**

Observations were made at 63x magnification with a Leica MZ12.5 dissecting microscope. Measurements were made with a dual-axis micrometer stage with output in increments of 0.001 mm. However, variation in specimen orientation, alignment of crosshairs with edges of structures, and interpretation of structure boundaries resulted in measurement accuracy to the nearest 0.02 to 0.005mm, depending on sharpness of the defined boundary. All measurements are presented in mm.

A complete set of measurements is presented for at least one specimen of each worker caste. Three primary measurements—HL, HW, and SL—are the most important for locating species in morphology space. For these measurements, an attempt was made to measure up to ten specimens of each worker caste, depending on availability of material. Inter-colony variation is much higher than intra-colony variation, so specimens from different collection events were chosen for measurements.

All holotypes and paratypes associated with the new species described here have unique specimen-level identifiers ("specimen codes") affixed to each pin. The specimen codes are listed for holotypes. Specimen codes should not be confused with collection codes, which are associated with particular collection events. When reported, collection codes follow the collector. Specimen collection data are derived from a specimen database and are not direct transcriptions of labels. The new species reported here were collected in the context of large-scale biodiversity surveys and in many cases are represented by tens to more than 100 collection events from small areas. The Additional Material Examined section does not exhaustively list these



collections; instead a representative record from each local collection site (areas of approximately 2km radius) is reported. Images of holotypes, distribution maps, and all specimen data on which this paper is based are available on AntWeb ([www.antweb.org](http://www.antweb.org)).

Wilson (2003) designated lectotypes for many *Pheidole* species. However, the designations were by implication, without an explicit statement such as "here designated," as currently required by the Zoological Code of Nomenclature (Declaration 44, amendment of Article 74.7.3, [www.iczn.org/Declaration44.htm](http://www.iczn.org/Declaration44.htm)). For relevant taxa in this work, those designations are formalized with the statement "here designated, as labeled by Wilson 2003."

For new species, the diagnosis generally follows the form "With the morphometric profile of *Pheidole* sp-x, *P. sp-y*, [...]," followed by the contrasting states of the new species and the morphometrically similar species. Thus the diagnosis depends on a somewhat vaguely defined neighborhood of morphometrically similar species, as determined by the current version of the Lucid *Pheidole* key, followed by more detailed differentiation of those species.

### 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/>) and/or the Registry of Biological Repositories (<http://www.biorepositories.org/>):

|        |  |
|--------|--|
| BMNH   | The Natural History Museum, London, U.K.   |
| CAS    | California Academy of Sciences, San Francisco, CA, USA.  |
| DEIB   | Deutsches Entomologisches Institut, Eberswalde Finow, Germany.   |
| EAPZ   | Escuela Agrícola Panamericana, Tegucigalpa, Honduras.  |
| ECOSCE | Colección Entomológica de El Colegio de la Frontera Sur, Unidad San Cristóbal, Chiapas, Mexico.              |
| FMNH   | Field Museum of Natural History, Chicago, IL, USA.   |
| ICN    | Insect Collection, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá D.C., Colombia. |
| INBC   | Instituto Nacional de Biodiversidad, Costa Rica.   |
| JTLC   | John T. Longino, personal collection, Olympia, WA, USA.  |
| LACM   | Los Angeles County Museum of Natural History, Los Angeles, CA, USA.  |
| MCSN   | Museo Civico di Storia Naturale "Giacomo Doria," Genoa, Italy.   |
| MCZ    | Museum of Comparative Zoology, Cambridge, MA, USA.   |
| MEL    | Museo Entomológico de León, León, Nicaragua.   |
| MHNG   | Muséum d'Histoire Naturelle, Geneva, Switzerland.  |
| MIZA   | Museo del Instituto de Zoología Agrícola, Universidad Central de Venezuela, Maracay, Venezuela.              |
| MZSP   | Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil.   |
| NMW    | Naturhistorisches Museum, Vienna, Austria.   |
| UCD    | University of California, Davis, CA, USA.  |
| UNAM   | Universidad Nacional Autónoma de México, México D. F., México.   |
| USNM   | National Museum of Natural History, Washington, DC, USA.   |
| UVGC   | Colección de Artrópodos, Universidad del Valle de Guatemala, Guatemala City, Guatemala.                      |
| ZMUC   | Natural History Museum of Denmark, University of Copenhagen, Denmark.  |

### Taxonomic Synopsis

*Pheidole acamata* Wilson, 2003

*Pheidole angusticeps* Wilson, 2003

= *Pheidole gradifera* Wilson, 2003 **new synonymy**  
*Pheidole arachnion* Wilson, 2003  
 = *Pheidole iracunda* Wilson, 2003 **new synonymy**  
*Pheidole bigote* **new species**  
*Pheidole bilimeki* Mayr, 1870  
 = *Pheidole rectiluma* Wilson, 2003 **new synonymy**  
*Pheidole boliviana* Wilson, 2003  
 = *Pheidole mincana* Wilson, 2003 **new synonymy**  
 = *Pheidole scitula* Wilson, 2003 **new synonymy**  
*Pheidole boltoni* Wilson, 2003  
 = *Pheidole humida* Wilson, 2003 **new synonymy**  
*Pheidole branstetteri* **new species**  
*Pheidole carinote* **new species**  
*Pheidole debilis* **new species**  
*Pheidole deceptrix* Forel, 1899  
 = *Pheidole chiapasana* Wilson, 2003 **new synonymy**  
 = *Pheidole variceps* Wilson, 2003 **new synonymy**  
*Pheidole eowilsoni* **new species**  
*Pheidole epiphyta* **new species**  
*Pheidole erratilis* Wilson, 2003  
 = *Pheidole petersoni* Wilson, 2003 **new synonymy**  
*Pheidole exarata* Emery, 1896  
 = *Pheidole grantae* Forel, 1908 **new synonymy**  
*Pheidole fossimandibula* **new species**  
*Pheidole gymnoceras* **new species**  
*Pheidole harrisonfordi* Wilson, 2003  
 = *Pheidole prolixa* Wilson, 2003 **new synonymy**  
 = *Pheidole ruida* Wilson, 2003 **new synonymy**  
 = *Pheidole tenebra* Wilson, 2003 **new synonymy**  
*Pheidole innupta* Menozzi, 1931 **revived status**  
*Pheidole janzeni* **new species**  
*Pheidole karolmorae* **new species**  
*Pheidole karolsetosa* **new species**  
*Pheidole lagunculinoda* **new species**  
*Pheidole laselva* Wilson, 2003  
 = *Pheidole ebenina* Wilson, 2003 **new synonymy**  
*Pheidole leoncortesi* **new species**  
*Pheidole mackayi* Wilson, 2003  
*Pheidole mesomontana* **new species**  
*Pheidole mooreorum* Wilson, 2003  
 = *Pheidole fariasana* Wilson, 2003 **new synonymy**  
*Pheidole nebulosa* Wilson, 2003  
 = *Pheidole scabriventris* Wilson, 2003 **new synonymy**  
*Pheidole nitidicollis* Emery, 1896  
 = *Pheidole sagana* Wheeler, 1934 **new synonymy**  
*Pheidole pararugiceps* **new species**  
*Pheidole perpusilla* Emery, 1894  
 = *Pheidole breviscapa* Forel, 1899 **new synonymy**  
 = *Pheidole decem* Forel, 1901  
 = *Pheidole emersoni* Wheeler, 1922  
*Pheidole phanigaster* **new species**  
*Pheidole picobarva* **new species**  
*Pheidole potosiana* Wilson, 2003  
*Pheidole psilogaster* Wilson, 2003  
*Pheidole pubiventris* Mayr 1887  
 = *Pheidole variegata* Emery 1896 **new synonymy**  
 = *Pheidole indistincta* Forel 1899 **new synonymy**  
 = *Pheidole cearensis* Forel 1901  
 = *Pheidole nevadensis* Forel 1901

= *Pheidole timmii* Forel 1901  
*Pheidole purpurea* **new species**  
*Pheidole radoszkowskii* Mayr, 1884  
 = *Pheidole medialis* Wilson, 2003 **new synonymy**  
*Pheidole rhinoceros* Forel, 1899  
*Pheidole rhinomontana* **new species**  
*Pheidole sculptior* Forel, 1893  
 = *Pheidole tayrona* Wilson, 2003 **new synonymy**  
*Pheidole sebofila* **new species**  
*Pheidole sparsisculpta* **new species**  
*Pheidole susannae* Forel, 1886  
 = *Pheidole obscurior* Forel, 1886 **new synonymy**  
 = *Pheidole partita* Mayr, 1887 **new synonymy**  
 = *Pheidole atricolor* Forel, 1901  
 = *Pheidole evoluta* Borgmeier, 1929  
*Pheidole synanthropica* **new species**  
*Pheidole tenuicephala* **new species**  
*Pheidole texticeps* Wilson, 2003  
 = *Pheidole perdiligens* Wilson, 2003 **new synonymy**  
*Pheidole vorax* (Fabricius 1804)  
 = *Pheidole cephalica* F. Smith, 1858 **new synonymy**  
 = *Pheidole opaca* Mayr, 1862 **new synonymy**  
 = *Pheidole incrustata* Forel, 1908 **new synonymy**  
 = *Pheidole sarrita* Forel, 1908 **new synonymy**  
 = *Pheidole apterostigmoides* Weber, 1943 **new synonymy**  
*Pheidole walkeri* Mann, 1922  
 = *Pheidole arietans* Wilson, 2003 **new synonymy**  
 = *Pheidole glyphoderma* Wilson, 2003 **new synonymy**  
 = *Pheidole triumbonata* Wilson, 2003 **new synonymy**

## Species Accounts

### *Pheidole acamata*

*Pheidole acamata* Wilson, 2003: 258, figs. Holotype major worker and associated paratype minor worker: Nicaragua, Kukra River 4 Mar 1992 (Perfecto). [MCZ] (examined).

### Geographic Range

Nicaragua, Mexico (Chiapas).

### Biology

This species occurs in wet forest habitats from sea level to 1000m elevation. It can be locally abundant. It is an epigeaic forager, common at baits, and often recruiting major workers along with minor workers. Workers are also collected in Winkler or Berlese samples. The nest is unknown.

### Comments

Throughout Central America a group of *Pheidole* share a distinctive character of the major worker: the gaster is covered with a plush layer of short, subdecumbent pubescence and any longer erect setae are absent or restricted to a few near the postpetiolar insertion. This contrasts with the rest of the body, which has a more "normal" condition, with abundant long suberect setae on the tibiae and mesosomal dorsum. In most *Pheidole* the general level of pilosity is similar over the body: if setae are sparse they are sparse throughout; if they are abundant they are abundant throughout, including the gastral dorsum.

Three named species are known to be in this complex, all described as new by Wilson (2003): *P. acamata*, *P. potosiana*, and *P. psilogaster*. Additional collections of this complex from Costa Rica and southern Mexico

allow some comments on character variation. Across all material the major workers are very uniform in habitus and there are no consistent differences in pilosity or sculpture that differentiate the three species. Thus, at this time the majors of the three species cannot be identified without associated minor workers. Two of the species, *P. potosiana* and *P. psilogaster*, have minor workers with smooth and shiny faces. The minor worker of *P. acamata* has a densely and uniformly foveolate face. The minor worker of *P. potosiana* has the dominant sculpture of the pronotum foveolate, with variable degrees of shiny patches and rugulae. The minor worker of *P. psilogaster* has the pronotum entirely smooth and shiny or largely smooth with some development of transverse rugulae anterodorsally. The three species show both broad and local patterns of sympatry.

The types of *P. acamata* from the Atlantic coastal lowlands of Nicaragua are identical to numerous collections from sites in the lowlands of northern Chiapas State, Mexico. The face and pronotum have reticulate rugae overlaying the foveolate sculpture, weak on the face and stronger on the pronotum, and the color is orange yellow. A population from one site in Chiapas near Salto de Agua is somewhat different: the minor workers have a duskier coloration and the reticulate rugulation on face and pronotum are much reduced to absent. These characters are more like *P. potosiana*. The two species are sympatric at Salto de Agua and are very similar there, differing only in the presence or absence of foveolate sculpture on the face.

Relatively few collections of *P. potosiana* have been examined. The types are from the state of San Luis Potosí, Mexico. The minor workers are uniformly red brown. The pronotum is largely foveolate, with smooth shiny patches on the side and dorsum. Collections from northern Chiapas lowlands are identical to the types or with the pronotum more uniformly foveolate, with shiny patches reduced to absent. A collection from Santa Rosa National Park in Costa Rica, in the dry forest of the northwestern lowlands, is nearly identical to the types, differing only in a somewhat darker brown coloration and slightly more developed transverse rugulae on the anterior pronotum. A few minor workers from further south in Costa Rica's Pacific lowlands are tentatively identified as *P. potosiana*.

*Pheidole psilogaster*, as here interpreted, shows considerable geographic variation in color of the body and sculpture of the pronotum. The types of *P. psilogaster* from Veracruz State, Mexico are nearly identical to material from the Atlantic lowlands of Costa Rica. The coloration is dark red brown and the pronotum is completely smooth and shining. Collections from the Osa Peninsula, on the southwest Pacific coast of Costa Rica, and from the northern Chiapas lowlands are yellow orange and the pronotum has faint rugulae and sometimes traces of faint foveolate sculpture overlaying the generally smooth and shining surface. Minor workers in this complex can be very similar to other species outside of the complex. For example, in the northern Chiapas lowlands *Pheidole acamata* and *P. erethizon*, both very common, have currently indistinguishable minor workers.

### ***Pheidole angusticeps***

*Pheidole angusticeps* Wilson, 2003: 609, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Guanacaste, Islas de Murciélagos, Isla San José, Santa Rosa National Park, 22 Oct 1992, tuna bait (Olson) [MCZ] (examined).

*Pheidole gradifer* Wilson, 2003: 613, figs. Holotype major worker and associated minor paratype worker: Costa Rica, Guanacaste, Santa Rosa National Park, 1km E station, 280m, 19 Oct 1992, tropical dry forest, tuna bait (Olson) [MCZ] (examined). Bolton et al. 2006: emended to *P. gradifera*. **New synonymy.**

### **Geographic Range**

Costa Rica.

### **Biology**

This species occurs in second growth dry forest habitats in northwestern Costa Rica. It has been collected at tuna baits on the ground, in samples of leaf litter, and as prey of *Neivamyrmex alfaroi*.

## Comments

The minor of *Pheidole angusticeps* has a narrow head, with CI 80–83. In the description of *Pheidole gradifera* the minor is reported to have CI 94 and the line drawing shows the head about as long as wide. However, this must be due to measurement error; the types of *P. gradifera* are typical *P. angusticeps*, and the minor worker has a narrow head.

## *Pheidole arachnion*

*Pheidole arachnion* Wilson, 2003: 656, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Prov. Cartago, Rio Reventazon, 3–5km E Turrialba, 18–22 Jan 1973 (W. L. Brown) [MCZ] (examined).

*Pheidole iracunda* Wilson, 2003: 712, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Prov. Heredia, La Selva Biological Station (Cover, Moffett, Tobin) [MCZ] (examined). **New synonymy.**

## Geographic Range

Costa Rica.

## Biology

This species occurs in wet forest habitats, from sea level to 1100m elevation. Workers, minors and majors, can be moderately abundant in Winkler or Berlese samples of forest floor litter but are rarely collected at baits. The lack of occurrence at baits suggests largely nocturnal foraging or foraging restricted to areas beneath litter or in rotten wood. One nest is known, from rotten wood on the forest floor.

## Comments

Numerous collections from the Atlantic lowlands of Costa Rica show that the differences between *P. arachnion* and *P. iracunda* cited by Wilson (2003) are intraspecific.

## *Pheidole bigote* new species

Figure 1

**Holotype major worker.** Mexico, Chiapas: Playón de la Gloria, 16.15149°N 90.89689°W, ±16m, 170m, 25 Jun 2008 (J. Longino#6396) [UNAM, unique specimen identifier CASENT0603300].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, MEL, UCD, UNAM, ICN, USNM, UVGC].

## Geographic Range

Mexico (Chiapas).

## Diagnosis

With the morphometric profile and general habitus of *P. fossimandibula* and *P. vestita*. **Minor worker:** transverse carina on anterior pronotum developed as a prominent flange visible in side view *versus* small (*fossimandibula*, *vestita*); mandible with basal portion roughened *versus* completely smooth and shining (*vestita*); side of propodeum only faintly foveolate and lacking rugulae *versus* with irregular rugulae overlaying foveolate sculpture (*fossimandibula*, *vestita*). **Major worker:** dorsal surface of mandible flat to weakly convex *versus* with broad concavity covering basal half of dorsal surface (*fossimandibula*); clypeus with large setal tufts in the form of pompons *versus* smooth and flat (*vestita*) or with weak gibbosities (*fossimandibula*), setae sparse to abundant but not in form of pompons (*fossimandibula*, *vestita*); face between frontal carinae with large hemispherical concavity *versus* simple, typically convex (*fossimandibula*, *vestita*).



**FIGURE 1.** *Pheidole bigote*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.

### **Description of minor worker**

*Measurements* (paratype): HL 0.64, HW 0.60, HLA 0.22, SL 0.57, EL 0.14, ML 0.79, PSL 0.01, PMG 0.00, SPL 0.03, PTW 0.11, PPW 0.14, CI 93, SI 95, PSLI 2, PMGI 0, SPLI 5, PPI 130.

*Measurements* (n=4): HL 0.64–0.69, HW 0.60–0.63, SL 0.57–0.60, CI 89–93, SI 95–99.

Mandible with faint rugulose-foveolate sculpture on base of dorsal surface, grading to smooth and shiny at masticatory margin; clypeus smooth and shining; face with about four widely-spaced concentric rugae around antennal insertion and a few longitudinal rugulae medial to compound eye, a few indistinct, arcuate carinulae on posterior face, otherwise face smooth and shining; posterior margin of vertex rounded; occipital carina narrow, visible in full face view; scape faintly foveolate, with abundant erect setae longer than maximum width of scape; promesonotum smoothly arched with no trace of promesonotal groove; anterior pronotum with a transverse carina that is elevated, flange-like, and distinctly visible as an anterior lip in lateral view; propodeal spines very short, upturned; promesonotum smooth and shining; katapisternum and lateral and dorsal faces of propodeum foveolate with overlying irregular rugulae; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with abundant suberect setae longer than maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with moderately abundant, long erect setae; color dark red brown.

### **Description of major worker**

*Measurements* (holotype): HL 1.73, HW 1.36, HLA 0.41, SL 0.61, EL 0.22, ML 1.41, PSL 0.05, PMG 0.00, SPL 0.07, PTW 0.29, PPW 0.49, IHT 0.25, OHT 0.54, CI 79, SI 45, PSLI 3, PMGI 0, SPLI 4, PPI 168, HTI 45.

*Measurements* (n=4): HL 1.67–1.73, HW 1.31–1.36, SL 0.61–0.63, CI 78–79, SI 45–47.

Mandible smooth and shining, somewhat flattened dorsally, with abundant piligerous puncta and an even covering of long decumbent yellow setae; clypeus with two large, horn-like gibbosities, but these covered from view by prominent tufts of yellow setae that are erect at base, densely clustered on gibbosities like sheaves of wheat, and then curve and become matted distally, forming globose pompons; frontal carinae slanting obliquely outward posteriorly, forming dorsal margins of prominent antennal scrobes, ventral margin of scrobe not sharply defined; scrobe, side of head, and vertex lobes coarsely reticulate rugose; area between frontal carinae and entire middle of face with a deep hemispherical concavity; anterior portion of concavity with dense layer of minute piligerous puncta from which arises a dense, short, yellow pubescence; posterior portion of concavity grading into regular concentric rugae with somewhat longer pubescence; rim of concavity with long, whisker-like setae laterally and posteriorly, basket-like; rest of face and sides of head with abundant erect setae; scape microsculptured and dull, not shining, terete at base, with abundant erect setae longer than maximum width of scape; hypostomal margin straight; median tooth small; inner hypostomal teeth pointed, stout, about one half distance from midline to outer hypostomal teeth; promesonotal groove absent; propodeal spines present; pronotum with reticulate rugae on humerus, sparse transverse carinulae anterolaterally, otherwise generally smooth and shining; rest of mesosoma generally shining, with some irregular rugulae and foveolae; dorsal (outer) margin of hind tibia with abundant suberect setae longer than maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view strongly lenticular, much broader than long; first gastral tergite with small patch of longitudinal etched microsculpture near postpetiolar insertion, smooth and shining elsewhere, with abundant long erect yellowish setae; color dark red brown.

### **Biology**

This species is known from a single nest excavation and a few minor workers at a bait at one lowland rainforest site in Chiapas, Mexico. The nest was in a clay bank at the edge of a small stream. The clay was stiff and highly plastic, like modeling clay, and could be carved out in slices with a pocket knife. The nest was low on the bank, close to the water level, and would undoubtedly be periodically inundated. The entrance was discovered by following workers from a cookie bait. There were three unadorned small entrance holes leading

to some chambers just under the surface of the bank. These were followed by a regular series of five chambers at descending levels, slanting into the bank. The chambers were horizontal, with flat floors and ceilings, and connected by narrow slanting tunnels. Minor workers, major workers, and brood were found in most chambers, and the lowest chamber contained a single colony queen. The lowest chamber was 12cm beneath the surface. No seeds were found in the chambers.

The nest was discovered while baiting workers at night, but minor workers were also taken at a bait during the day.

A sample of minor workers, major workers, and brood were kept alive for a few days in a petri dish with some clay from the nest excavation site. No special behavior of the major workers was observed; the ants simply remained clustered with the brood and somewhat inactive. The bizarre features of the major worker of this species demand further investigation of their function.

### Etymology

The name is in reference to the large "bigote" (mustache in Spanish) that projects from the clypeus.

### Comments

*Pheidole bigote*, *P. fossimandibula*, and *P. vestita* form a trio of species that are closely similar in most characters but show remarkable divergence and diversification in the anterior head of the major worker. The minor workers of the three species are very similar and hard to differentiate. For many years the minor workers of *P. fossimandibula* were misidentified as *P. vestita*, until nests with major workers of *P. fossimandibula* were discovered. The major workers of the three species are very similar in shape, pilosity, and sculpture of the metasoma, mesosoma, and posterior head, in the form of the antennal scrobes and hypostomal teeth. *Pheidole vestita* is the least derived of the group, with smooth convex mandibles and typical clypeus and face. The other two each have their own unique derived features. *Pheidole fossimandibula* has a deep concavity on the dorsal surface of the mandible, a character so far unprecedented in the genus. *Pheidole bigote* has the dorsal surface of the mandible somewhat flattened, not as convex as *P. vestita*, but not at all concave, and thus intermediate between *P. vestita* and *P. fossimandibula*. *Pheidole bigote* has the clypeal pompons and the dish-like face excavation, characters also unprecedented in the genus. *Pheidole fossimandibula* has clypeal gibbositities and a brush of yellow setae on the anterior face and clypeus, perhaps an intermediate condition from which the pompons of *P. bigote* evolved. The face excavation of *P. bigote* shows no trace of similar development in *P. vestita* or *P. fossimandibula*.

### *Pheidole bilimeki*

*Pheidole bilimeki* Mayr, 1870: 985. Lectotype major worker: Mexico (Bilimek) [NMW] (examined).

*Pheidole rectiluma* Wilson, 2003: 493, figs. Holotype major worker and associated paratype minor worker: Mexico, Tamaulipas, Sa. de Guatemala, Rancho del Cielo, 1070m, 23 Jul 1965 (Cornell Univ. Mexico Field Party) [MCZ] (examined). **New synonymy.**

### Comments

The *Pheidole bilimeki* complex was reviewed by Longino and Cox (2009) (full synonymy presented there). On subsequent examination of the types of *P. rectiluma*, they were found to fall within the range of variation of typical *P. bilimeki*. The types of *P. rectiluma* match the typical widespread dark form, not the yellow form of southern Mexico.

### *Pheidole boliviana*

*Pheidole boliviana* Wilson, 2003: 380, figs. Holotype major worker and associated paratype minor worker: Bolivia, Santa Cruz: Las Gamas, P. N. Noel Kempff Mercado, 14°48'S 60°28'W, 700 m (P. S. Ward#12270), ex rotten log [MCZ] (examined).



*Pheidole mincana* Wilson, 2003: 457, figs. Holotype major and associated paratype minor worker: Colombia, Magdalena: Minca, 610 m, 26 Mar 1977 (C. Kugler), cafetal [MCZ] (examined). **New synonymy.**

*Pheidole scitula* Wilson, 2003: 505, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Puntarenas Prov., Parque Nacional Corcovado, Llorona, 8°35'N 83°42'W, 2 Jan 1982 (Longino) [MCZ] (examined). **New synonymy.**

### Geographic Range

Bolivia, Colombia, Costa Rica.

### Biology

This species occurs in wet to moist forest habitats, from sea level to 800m elevation. Collections have been from second growth vegetation and a coffee plantation. Nests are in the low arboreal zone, within a meter or two of the ground but not in the leaf litter on the forest floor. Nests have been found in a small diameter dead stick and under loose bark of larger rotting trees.

### Comments

Comparison of the types of *P. boliviana*, *P. mincana*, and *P. scitula* revealed no notable geographic variation. In fact, it is remarkable how similar the types from Bolivia and Costa Rica are.

### *Pheidole boltoni*

*Pheidole boltoni* Wilson, 2003: 666, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Heredia, 8km N Volcan Barba, 10°12'N 84°06'W, 1830m, 4–14 Jul 1986 (Longino #1329) [MCZ] (examined).

*Pheidole humida* Wilson, 2003: 614, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Puntarenas, Monteverde, 1550m, 20 May 1979 (P. S. Ward #3450) [MCZ] (examined). **New synonymy.**

### Geographic Range

Costa Rica.

### Biology

This species is a montane cloud forest specialist. In the tropics ant abundance declines dramatically between 1500m and 2000m and ants are very difficult to find above 2000m. *Pheidole boltoni* occurs in a narrow band at the very upper edge of ants' natural occurrence. Several nests have been collected under epiphyte mats in recent branch and treefalls. One nest (the types of *P. humida*) was collected in a rotten log.

### Comments

The types of *P. humida* are very similar to types and additional material of *P. boltoni*, differing only in having a lighter color. Multiple collections of *P. boltoni* have been made at the peak of Volcan Barba in the Cordillera Volcanica Central. The type series of *P. humida* was collected in Monteverde, in the Cordillera de Tilarán. Oddly, no other material has been collected from Monteverde, in spite of intensive collecting there.

### *Pheidole branstetteri* new species

Figure 2

**Holotype major worker.** Mexico, Chiapas: Nahá, 16.96291°N 91.59335°W, ±100m, 985m, 10 Jun 2008 (LLAMA#Ba-A-07-1-01-07) [UNAM, unique specimen identifier CASENT0609076].

**Paratypes:** major and minor workers. Same data as holotype; Mexico, Chiapas: Nahá, 16.94860°N 91.59957°W, ±200m, 950m, 10 Jun 2008 (LLAMA#Ba-A-07-2-02-03 and Ba-A-07-2-02-12); Mexico,

Chiapas: Nahá, 16.97978°N 91.58544°W, ±100m, 860m, 12 Jun 2008 (LLAMA#Ba-A-07-3-03-02 and Ba-A-07-3-04-05) [BMNH, CAS, FMNH, INBC, LACM, MCZ, MZSP, UCD, UNAM, USNM].



**FIGURE 2.** *Pheidole branstetteri*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bars 1mm.

## Geographic Range

Mexico (Chiapas).

## Diagnosis

With the general habitus and morphometric profile of *P. texticeps*. Minor worker: face uniformly foveate *versus* smooth and shining (*texticeps*). Major worker: petiolar node in posterior view with dorsal margin distinctly bilobed, medially concave, wider than one half width of postpetiole, *versus* dorsal margin weakly convex, flat, or weakly concave, about one half width of postpetiole; face with vertex lobes always smooth and shiny *versus* usually with roughened sculpture extending almost or entirely to posterior margin of vertex, less often vertex lobes smooth and shiny; promesonotum with at most 2 very short setae, variably located, *versus* promesonotum usually with three pairs of stiff short erect setae, less often with fewer; gastral dorsum always devoid of erect setae *versus* usually with at least a few stiff erect setae, rarely totally lacking (*texticeps*).

## Description of minor worker

*Measurements* (paratype): HL 0.66, HW 0.59, HLA 0.24, SL 0.72, EL 0.14, ML 0.81, PSL 0.09, PMG 0.03, SPL 0.03, PTW 0.13, PPW 0.18, CI 90, SI 122, PSLI 13, PMGI 5, SPLI 5, PPI 137.

*Measurements* (n=14): HL 0.59–0.70, HW 0.56–0.66, SL 0.63–0.78, CI 85–98, SI 102–132.

Mandible smooth and shining; clypeus faintly foveolate, overlain with reticulate rugulae; face uniformly foveolate, occasionally overlain with weak rugulae; margin of vertex uniformly rounded or flattened with median impression; occipital carina narrow, not or barely visible in full face view; scape with sparse erect setae longer than maximum width of scape; promesonotal groove strongly impressed; propodeal spines present; pronotal dorsum foveolate, overlain with reticulate rugulae; side of pronotum foveolate anteriorly and smooth and shiny posteriorly, or entirely foveolate; katapisternum and dorsal and lateral faces of propodeum uniformly foveate with variable presence of overlying rugulae; promesonotal dorsum with about six pairs short stiff erect setae; dorsal (outer) margin of hind tibia with decumbent pubescence and 0–3 suberect setae subequal in length to maximum width of tibia; first gastral tergum smooth and shining or with small area of faint foveolate sculpture near postpetiolar insertion; gastral dorsum with sparse stiff erect setae; color orange.

## Description of major worker

*Measurements* (holotype): HL 1.01, HW 1.05, HLA 0.34, SL 0.72, EL 0.19, ML 1.01, PSL 0.09, PMG 0.05, SPL 0.05, PTW 0.26, PPW 0.35, IHT 0.36, OHT 0.43, CI 104, SI 68, PSLI 9, PMGI 5, SPLI 4, PPI 131, HTI 84.

*Measurements* (n=7): HL 0.92–1.04, HW 0.92–1.17, SL 0.69–0.73, CI 99–113, SI 60–75.

Mandible smooth and shiny; clypeus smooth and flat with pronounced anterior notch; anterior face foveolate overlain with reticulate rugulae, grading to foveolate between frontal carina and compound eye, grading to smooth and shining on vertex lobes, medial area between frontal carinae foveolate overlain with longitudinal carinulae; head with no setae projecting from lateral or posterior margins of head in face view; scape smooth and shining, terete at base, with appressed pubescence and 1–3 suberect setae, these shorter than maximum width of scape; hypostomal margin gently curved; median tooth at most an inconspicuous gibbosity; inner hypostomal teeth thin and pointed, much closer to outer hypostomal teeth than to midline; promesonotal groove strongly impressed; propodeal spines present; pronotal dorsum weakly foveolate rugulose, anterior margin and sides smooth and shining; katapisternum, lateral and dorsal faces of propodeum foveolate; dorsal (outer) margin of hind tibia with short appressed pilosity only, no long erect hairs; mesosomal dorsum devoid of erect setae or with 1–2 very short, irregularly located stiff erect setae; petiolar node in posterior view with dorsal margin distinctly bilobed, medially concave, wider than one half width of postpetiole; in dorsal view postpetiole lenticular but not strongly conulate, smooth and shining or very faintly foveolate; first gastral tergite smooth and shining, completely devoid of erect setae; color orange.

## Biology

This species occurs in lowland rainforest to cloud forest. It is known most abundantly from baits on the forest floor, and major workers are often found with minor workers at baits. Minor workers are also occasionally collected in Winkler samples of sifted leaf litter. Isolated minor workers from the Sierra Madre de Chiapas (see Comments), tentatively identified as this species, were also collected in beating samples.

## Etymology

This species is named for Michael Branstetter, a student of myrmecology and an indispensable participant in the LLAMA project.

## Comments

This species is most thoroughly known from rainforest areas of northern Chiapas, Mexico. Isolated minor workers from the Sierra Madre de Chiapas are tentatively identified as this species, but there are slight differences in morphology and no major workers have been collected to support the identification.

## Additional material examined

MEXICO: Chiapas, Sierra Morena, 16°09'15"N, 093°35'23"W, 1150m (J. Longino); 2.8km NE Coapilla, 17°09'10"N, 093°08'46"W, 1700m (J. Longino); Lagos de Montebello, Cinco Lagos, 16°06'04"N, 91°40'27"W, 1600m (R. S. Anderson); 12km NW Flor de Cafe, 16°08'25"N, 91°16'17"W, 520m (R. S. Anderson); Sierra Morena, 16°09'41"N, 93°36'02"W, 1325m (LLAMA); 2km SE Custepec, 15°43'16"N, 92°57'02"W, 1520m (LLAMA); Playón de la Gloria, 16°09'33"N, 90°54'06"W, 160m (LLAMA); Lago Metzabok, 17°07'34"N, 91°37'50"W, 570m (LLAMA).

## *Pheidole carinote* new species

Figure 3

**Holotype major worker.** Costa Rica, Puntarenas: 13km SSW Pto. Jimenez, 8.40667°N 83.32833°W, ±200m, 130m, 10 Mar 2008 (J. Longino#6209-51) [INBC, unique specimen identifier JTLC000014045].

**Paratypes:** major and minor workers. Same data as holotype; same data as holotype but J. Longino#6209-40, 6209-53, 6209-59, 6209-60, 6207-s; Costa Rica, Puntarenas: 10km SW Pto. Jimenez, 8.46553°N 83.36928°W, ±30m, 240m, 12 Mar 2008 (J. Longino#6197-s) [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, MEL, UCD, UNAM, ICN, USNM, UVGC].

## Geographic Range

Costa Rica.

## Diagnosis

With the morphometric profile and habitus of *P. harrisonfordi* (with which it is sympatric) and many other small *Pheidole*. The frontal carinae of the minor worker are greatly enlarged, laminar, and projecting over the clypeus, a condition unique to this species. The major workers are very similar to major workers of *P. harrisonfordi*, but with frontal carinae larger, more elevated and slightly projecting (the frontal carina character is less well developed in major workers than minor workers, and makes majors of *P. carinote* more difficult to identify than minor workers).



**FIGURE 3.** *Pheidole carinote*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for A, E, F, 1mm for others.

### Description of minor worker

*Measurements* (paratype): HL 0.50, HW 0.47, HLA 0.17, SL 0.40, EL 0.09, ML 0.55, PSL 0.07, PMG 0.00, SPL 0.03, PTW 0.09, PPW 0.14, CI 95, SI 84, PSLI 13, PMGI 0, SPLI 6, PPI 159.

*Measurements* (n=10): HL 0.43–0.50, HW 0.41–0.47, SL 0.35–0.42, CI 91–95, SI 84–89.

Mandible smooth and shining; anterior clypeus smooth and shining with 2–4 longitudinal rugulae, posterior clypeus between frontal carinae obscurely foveolate; frontal carinae expanded anteriorly as rounded laminar plates that project freely over clypeus; face uniformly foveolate; margin of vertex rounded with median impression; occipital carina narrow, not visible in full face view; scape foveolate, with abundant suberect to decumbent setae equal to or shorter than maximum width of scape; promesonotal groove absent; propodeal spines present; entire mesosoma foveolate; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with short subdecumbent setae, shorter than maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with moderately abundant erect setae; color red brown.

### Description of major worker

*Measurements* (holotype): HL 0.91, HW 0.85, HLA 0.25, SL 0.44, EL 0.13, ML 0.72, PSL 0.07, PMG 0.00, SPL 0.04, PTW 0.16, PPW 0.34, IHT 0.17, OHT 0.35, CI 94, SI 52, PSLI 7, PMGI 0, SPLI 5, PPI 214, HTI 47.

*Measurements* (n=9): HL 0.81–0.94, HW 0.77–0.87, SL 0.42–0.45, CI 93–97, SI 48–55.

Mandible smooth and shiny; clypeus smooth and shiny, flat to slightly concave anteriorly, anterior border emarginate; posterior portion with obsolete foveolation laterally; frontal carina expanded into bluntly triangular lamina, elevated and projecting a short distance over clypeus; face foveolate throughout, overlain with longitudinal rugulae between frontal carinae and between frontal carina and compound eye, grading to reticulate rugulae on scrobal area, fading completely on vertex lobes; head with abundant suberect setae projecting from sides of head in face view; scape foveolate, terete at base, with abundant erect setae subequal in length to maximum width of scape; hypostomal margin flat; median tooth a small, blunt gibbosity; inner hypostomal teeth pointed, stout, closer to midline than to outer hypostomal teeth; promesonotal groove absent; propodeal spines present; mesosoma largely foveolate; dorsal (outer) margin of hind tibia with suberect to decumbent setae, the longest of which subequal in length to maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view transverse, with well-developed conules; first gastral tergite with obsolete foveolate sculpture anteriorly, grading to smooth and shining posteriorly, with abundant erect to suberect setae; color red brown.

### Biology

This species occurs in lowland rainforest leaf litter. It is known from numerous Winkler samples of sifted leaf litter from the Osa Peninsula in Costa Rica. Major workers and minor workers occur in Winkler samples. A minor worker was collected in the stomach contents of a dendrobatid frog ("*Dendrobates granuliferus*" on label).

### Etymology

The name is in reference to the large frontal carinae of the minor worker.

### Additional material examined

COSTA RICA: Puntarenas, Rincón, 8°40'N, 83°28'W, 50m (USC-CRE); Sirena, Corcovado National Park, 8°29'N, 83°36'W, 50m (J. Longino); Rancho Quemado, Osa Peninsula, 8°42'N, 83°33'W, 200m (J. Longino).

## *Pheidole debilis* new species

Figure 4

**Holotype major worker.** Costa Rica, Heredia: 16km SSE La Virgen, 10.26667°N 84.08333°W, ±2000m, 1100m, 15 Feb 2001 (R. Vargas#01-RVC-015) [INBC, unique specimen identifier INB0003622662].

**Paratypes:** major and minor workers. Same data as holotype; same locality as holotype but 17 Nov 2000 (J. Longino#4361) [BMNH, CAS, FMNH, INBC, LACM, MCZ, UCD, USNM].

### Geographic Range

Costa Rica.

### Diagnosis

With the morphometric profile of *P. gnomus*, *P. mera*, *P. sparsisculpta*, and *P. sospes*. Minor worker: face foveolate with overlying rugulae *versus* face uniformly foveolate, without overlying rugulae (*mera*, *sospes*) or with extensive smooth areas (*sparsisculpta*); lateral pronotum foveolate *versus* with smooth shiny patch (*mera*); minor worker of *gnomus* unknown. Major worker: vertex lobes weakly sculptured with faint foveolate sculpture *versus* vertex lobes with pronounced transversely arcuate rugae (*gnomus*), or coarsely reticulate rugose (*sospes*), or completely smooth and shining (*sparsisculpta*); head in lateral view normally convex *versus* with pronounced medial bulge on face (*gnomus*); lacking antennal scrobe *versus* with shallow but distinct antennal scrobe (*mera*, *sospes*); promesonotal groove present *versus* promesonotum evenly arched, with no trace of promesonotal groove (*mera*).

### Description of minor worker

*Measurements* (paratype): HL 0.52, HW 0.49, HLA 0.17, SL 0.42, EL 0.09, ML 0.60, PSL 0.06, PMG 0.00, SPL 0.03, PTW 0.09, PPW 0.14, CI 93, SI 86, PSLI 11, PMGI 0, SPLI 6, PPI 152.

*Measurements* (n=13): HL 0.46–0.55, HW 0.42–0.49, SL 0.36–0.46, CI 88–93, SI 84–95.

Clypeus smooth with 1–3 longitudinal rugulae; eye small, with fewer than 10 ommatidia; face densely foveolate, overlain with reticulate rugulae; margin of vertex flattened with weak median impression; occipital carina narrow, not visible in full face view; scape with abundant subdecumbent to suberect setae, mostly shorter than maximum width of scape; promesonotal groove weakly impressed; propodeal spines present; entire mesosoma foveolate, overlain with faint reticulate rugulae on promesonotal dorsum; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with short decumbent pilosity, no long erect setae; first gastral tergum smooth and shining; gastral dorsum with moderately abundant suberect setae; color variable, light to dark red brown.

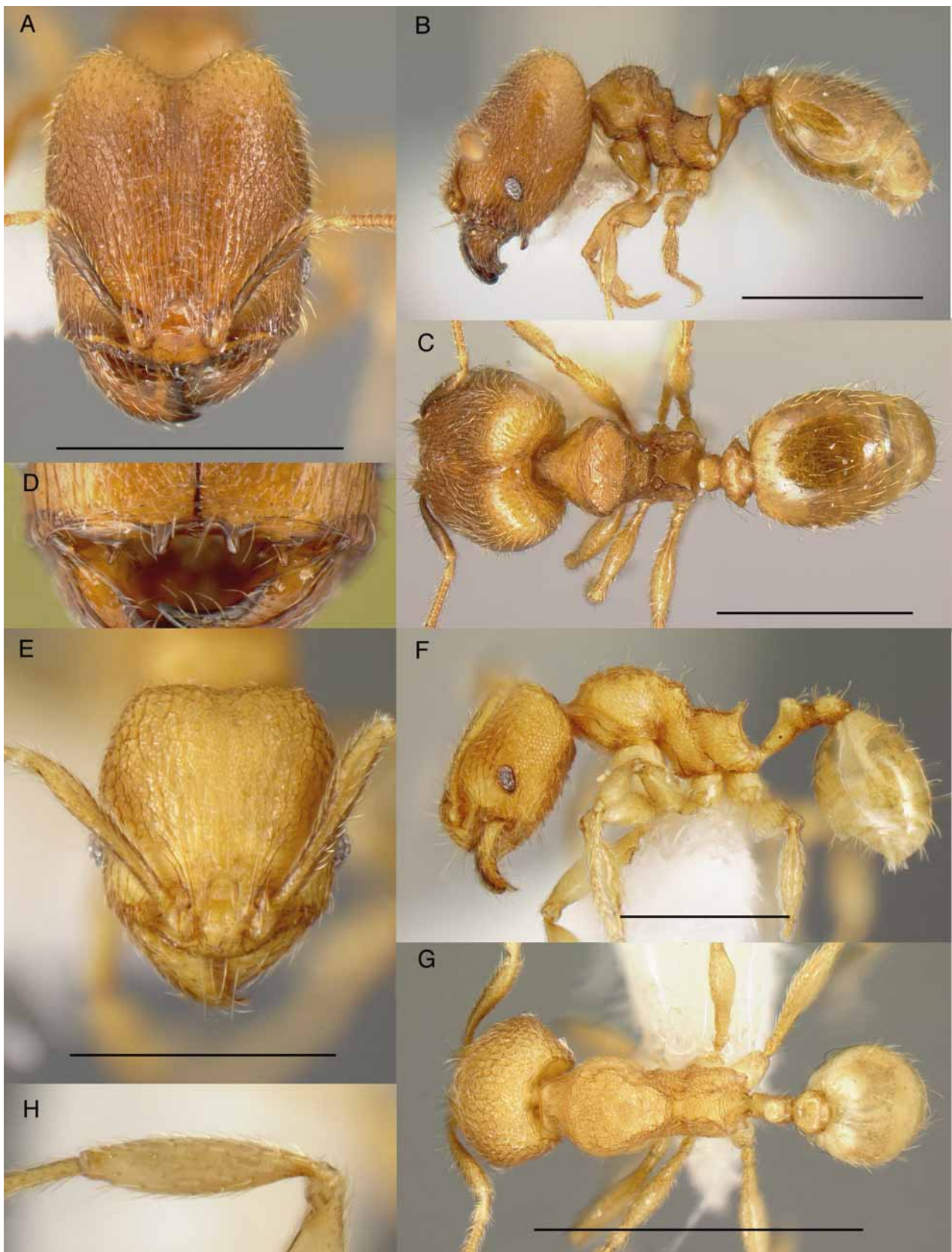
### Description of major worker

*Measurements* (holotype): HL 1.13, HW 0.94, HLA 0.30, SL 0.48, EL 0.14, ML 0.81, PSL 0.06, PMG 0.02, SPL 0.06, PTW 0.19, PPW 0.38, IHT 0.18, OHT 0.41, CI 83, SI 51, PSLI 5, PMGI 2, SPLI 6, PPI 204, HTI 43.

*Measurements* (n=11): HL 0.92–1.15, HW 0.80–1.04, SL 0.42–0.52, CI 81–88, SI 50–56.

Mandibles smooth and shiny; clypeus smooth and shallowly concave, with shallow anterior notch, and very weak posteromedian gibbosity or carina; face with longitudinal rugulae on cheeks and between frontal carinae, grading to faint foveolate sculpture overlain with reticulate rugulae on scrobe, fading to very faint foveolate sculpture on posterior vertex lobes; scrobe a faint, unbounded impression; head with abundant suberect setae projecting from sides of head in face view; scape smooth and shining, terete at base, with subdecumbent pubescence and scattered longer suberect setae; hypostomal margin flat; median tooth small; inner hypostomal teeth pointed, stout, closer to midline than to outer hypostomal teeth; promesonotal groove impressed; propodeal spines present; mesosoma with a mix of foveolate, smooth, and rugulose sculpture; dorsal (outer) margin of hind tibia with short decumbent pilosity, no long erect hairs; pilosity abundant on

mesosomal dorsum; first gastral tergite smooth and shining, with abundant flexuous erect setae; color orange brown.



**FIGURE 4.** *Pheidole debilis*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, F, 1mm for others.



## Biology

*Pheidole debilis* occurs in wet forest leaf litter. It is most often collected in Winkler samples of sifted litter but is rarely collected at baits. Major workers may occur together with minor workers in Winkler samples. One nest was collected in soil, and one nest was collected from rotten wood.

## Etymology

The name is in reference to the faint sculpture on the face of the major worker, compared to *P. harrisonfordi* and other common litter ants that have more heavily sculptured major workers.

## Comments

This species is mainly known from the Barva Transect in Braulio Carrillo National Park, on the Atlantic slope of Costa Rica. It is moderately abundant across a range of elevations, from La Selva Biological Station to 1500m. Minor workers tentatively assigned to this species have been collected elsewhere in Costa Rica: Hitoy Cerere, the Monteverde area, and the southern Pacific lowlands. A collection of minor workers in a Winkler sample from the Osa Peninsula also contained a major worker that matches the typical form in most respects, differing in the lack of any clypeal gibbosity or carina, and the presence of shiny patches on the antennal scrobes.

In Costa Rica, minor workers of this species can be distinguished from the common *P. harrisonfordi* by more pronounced rugulae on the face and mesosomal dorsum, the slightly impressed promesonotal groove, and the lack of any longer setae above the short, subdecumbent pilosity on the hind tibia. However, these distinctions do not hold over the broad concept of *P. harrisonfordi* as a whole (see Comments under *P. harrisonfordi*). Minor workers are distinguished from the similar *P. beloiceps* by the foveolate side of the pronotum (smooth and shiny on *P. beloiceps*). Major workers are distinguished from *P. beloiceps* by having a relatively broader head and having the scrobe foveolate (small shiny patches on *P. beloiceps*).

## Additional material examined

COSTA RICA: Heredia, La Selva Biological Station, 10°25'N, 84°01'W, 50m (numerous collectors and collections); 16km SSW Pto. Viejo, 10°19'03"N, 84°02'56"W, 500m (numerous collectors and collections); Cantarrana, 11km ESE La Virgen, 10°20'43"N, 84°03'28"W, 300m (numerous collectors and collections); Vara Blanca, 10km NE Vara Blanca, 10°14'N, 84°05'W, 1500m (numerous collectors and collections); Limón, Hitoy Cerere Biol. Reserve, 9°40'N, 83°02'W, 200m (J. Longino); Puntarenas, Monteverde, 10°18'N, 84°48'W, 1500m (L. A. Schonberg); Bijagual, Carara Biol. Reserve, 9°47'N, 84°36'W, 500m (J. Longino); Est. Biol. Los Llanos, near Santa Elena, 10°18'18"N, 84°50'14"W, 1150m (J. Longino); 13km SSW Pto. Jimenez, 8°24'24"N, 83°19'42"W, 130m (J. Longino).

## *Pheidole deceptrix*

*Pheidole deceptrix* Forel, 1899: 66, pl. 3, fig. 20. Lectotype major worker (here designated, as labeled by Wilson 2003) and associated paralectotype minor worker: Guatemala, Baja Verapaz, Purulha (Champion) [MHNG] (examined). See also: Wilson, 2003: 679.

*Pheidole chiapasana* Wilson, 2003: 273, figs. Holotype major worker and associated paratype minor worker: Mexico, Chiapas, 5km E Rayón, 17°13'N 92°58'W, 1700m, 23 Dec 1991 (P. S. Ward #11581-12) [MCZ] (examined). **New synonymy.**

*Pheidole variceps* Wilson, 2003: 775, figs. Holotype major worker and associated paratype minor worker: Mexico, Chiapas, 6km SE San Cristobal de las Casas, 10 Aug 1978 (J. Rawlins) [MCZ] (examined). **New synonymy.**

## Geographic Range

Guatemala, Mexico (Chiapas).

## Biology

This species is a montane specialist, occurring in cloud forest habitats from 1300–2750m elevation. Nests are in the soil and under stones. Foragers, including major workers, come to baits on the forest floor, and workers are collected in Berlese and Winkler samples. Alate queens were collected 11 July 2007, at Cerro Huitepec in Chiapas. Males remain unknown.

## Comments

The type major worker of *P. deceptrix* has the median and rear portion of the face with shallow foveolate sculpture overlain with sparse rugulae, and the postpetiole in dorsal view is trapezoidal. The associated minor worker has the face and mesosoma uniformly and densely foveolate. The type major worker of *P. variceps* has similar sculpture on the face but it fades posteriorly, leaving the vertex lobes smooth and shiny. The postpetiole in dorsal view is more transverse, with more acutely angulate sides. The minor worker has the face and mesosoma with a mix of smooth shiny areas and patches of faint foveolate sculpture. However, multiple collections from additional localities show continuous variation between these two forms. The variation is geographically structured, such that multiple collections from the same site show little variation compared to differences among sites. I interpret this as one polytypic species with slightly different forms in different mountain ranges.

## *Pheidole eowilsoni* new species

Figure 5

**Holotype major worker.** Costa Rica, Alajuela: Casa Eladio, Rio Peñas Blancas, 10.31667°N 84.71667°W, ±2000m, 800m, 2 Mar 2008 (J. Longino#6149) [INBC, unique specimen identifier CASENT0608897].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, MEL, UCD, UNAM, ICN, USNM, UVGC].

## Geographic Range

Costa Rica.

## Diagnosis

The morphometric profile, sculptural details, and pilosity pattern are unique in this highly distinctive species. Minor worker: the combination of large size, generally shiny mesosoma, dark color, and long, thin, nearly perpendicular propodeal spines are distinctive. Major worker: face foveolate rugulose laterally, grading to smoother and sublucid on vertex lobes, but vertex lobes still sculptured with faint mesh of foveolae and coarse piligerous puncta, *versus* more uniformly foveolate rugose and not shining (*vorax*) or entirely rugose (*rhea*); scape curved at base, base slightly flattened, about as wide at curvature as maximum width at apex, *versus* thin at base and less curved (*astur*); antennal club 3-segmented *versus* 4-segmented (*dwyeri*); color dark brown and dorsal surface of mandible with erect setae *versus* color orange brown and dorsal surface of mandible lacking erect setae (*praeses*).

## Description of minor worker

*Measurements* (paratype): HL 1.07, HW 0.98, HLA 0.41, SL 1.20, EL 0.18, ML 1.48, PSL 0.19, PMG 0.01, SPL 0.04, PTW 0.16, PPW 0.29, CI 92, SI 122, PSLI 17, PMGI 1, SPLI 4, PPI 184.

*Measurements* (n=10): HL 0.65–1.13, HW 0.59–1.04, SL 0.92–1.24, CI 89–92, SI 119–156.

Mandible smooth and shining; clypeus smooth and shining with median carina; face shining with very faint mesh of foveolae, only visible in certain lighting conditions; margin of vertex rounded; occipital carina narrow, visible in full face view; scape with abundant subdecumbent setae less than or equal to maximum width of scape; promesonotal groove weakly impressed, promesonotum forming more or less continuous arched convexity; pronotal humerus weakly produced as a quadrate boss; propodeal spines long, thin, nearly

perpendicular to dorsal face of propodeum; mesosoma generally smooth and shiny, with very faint foveolate mesh, similar to face, on sides of pronotum, juncture of katapisternum and anepisternum, posterior katapisternum, propodeum, petiole, and postpetiole; 3 strong parallel carinae on metapleural bulla; ventral margin of postpetiole slightly produced anteriorly, forming short step anteriorly; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with subdecumbent setae and longer suberect setae subequal in length to maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with abundant, long, suberect setae; color dark red brown with lighter brown legs.

### **Description of major worker**

*Measurements* (holotype): HL 2.75, HW 2.58, HLA 0.72, SL 1.32, EL 0.29, ML 2.20, PSL 0.25, PMG 0.00, SPL 0.10, PTW 0.37, PPW 0.80, IHT 0.45, OHT 0.98, CI 94, SI 51, PSLI 9, PMGI 0, SPLI 4, PPI 216, HTI 46.

Mandibles smooth and shiny; medial clypeus smooth and flat with a few longitudinal rugulae laterally, beneath frontal carinae; frontal carina short, forming vertical flange above antennal insertion; face with longitudinal carinulae between frontal carina and compound eye, grading to foveolate rugulose sculpture posteriorly, grading to smoother on vertex lobes, but vertex lobes still sculptured with faint mesh of foveolae and coarse piligerous puncta; medial area between frontal carinae with a sharp median carina and radiating fan of longitudinal carinulae; head with abundant suberect setae projecting from sides of head in face view; scape curved at base, base slightly flattened, about as wide at curvature as maximum width at apex, with abundant erect setae longer than maximum width of scape; hypostomal margin flat; median tooth absent; inner hypostomal teeth stout, closer to midline than to outer hypostomal teeth; promesonotal groove weakly impressed; pronotal humerus strongly developed as blunt cone; propodeal spines present; anterodorsal pronotum and mesonotum with widely-spaced transverse rugulae; side of pronotum with irregular rugulae; katapisternum smooth and shining; lateral propodeum smooth and shining with 3 strong longitudinal carinae on metapleural bulla; dorsal (outer) margin of hind tibia with abundant suberect setae, some longer than maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiolar sternite foveolate, with pair of anterolateral gibbositities; first gastral tergite smooth and shining with very faint mesh of foveolae, with abundant flexuous suberect setae; color dark red brown.

### **Biology**

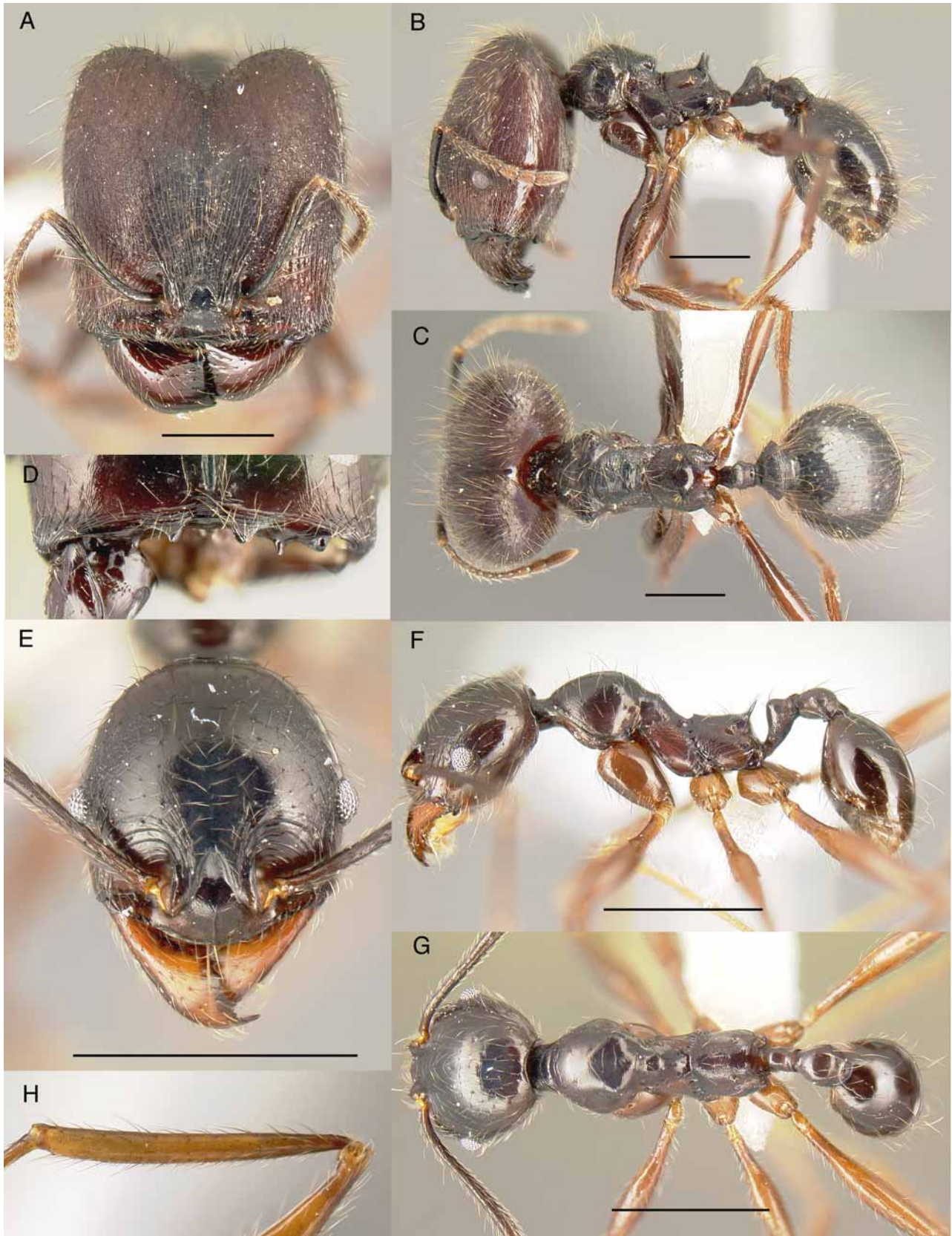
*Pheidole eowilsoni* occurs in mature wet forest. The type series was collected from a nest in a clay bank above a stream. Nocturnal foragers led to a simple hole in a vertical clay bank. The hole led into a tunnel about 1cm diameter. Nest excavation uncovered four chambers containing minor workers, major workers, and brood. One chamber contained a single colony queen. The volume occupied by the nest was about 20cm across and 20cm deep in the bank. One chamber contained what appeared to be an internal trash midden. Among general debris the midden contained nematodes, the remains of a dead *Myrmelachista* queen, and a few small plant seeds. A second collection was a founding queen with a few minor workers, beneath a stone in a rainforest trail. Minor workers were collected in a pan trap near a stream.

### **Etymology**

This species is named in honor of E. O. Wilson, whose pioneering work on *Pheidole* has made the present work possible.

### **Comments**

Two collections from 500m elevation on the Barva Transect in Braulio Carrillo National Park and the type series from 800m in the Peñas Blancas Valley have minor workers that are nearly identical to each other. A series of isolated minor workers from 50–500m on the Barva Transect, collected in Winkler and Berlese samples, are tentatively identified as *P. eowilsoni* but the clypeus lacks a median carina and the ventral margin of the postpetiole is completely flat.



**FIGURE 5.** *Pheidole eowilsoni*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bars 1mm.

### Additional material examined

COSTA RICA: Heredia, La Selva Biological Station, 10°25'N, 84°01'W, 50m (multiple collectors and collections); 16km SSW Pto. Viejo, 10°19'N, 84°03'W, 500m (multiple collectors and collections).

### *Pheidole epiphyta* new species

Figure 6

**Holotype major worker.** Costa Rica, Alajuela: Casa Eladio, Rio Peñas Blancas, 10.31667°N 84.71667°W, ±2000m, 800m, 3 Mar 2004 (J. Longino#5284) [INBC, unique specimen identifier CASENT0608898].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, MEL, UCD, UNAM, ICN, USNM, UVGC].

### Geographic Range

Costa Rica.

### Diagnosis

The morphometric profile of this species is unique. Minor worker: the combination of uniformly foveolate face and mesosoma, lack of promesonotal groove, very long posteriorly-directed propodeal spines, long scapes, and orange color is distinctive. Major worker: the combination of strongly cordate head, long scapes, uniformly foveolate sculpture over most of face, long propodeal spines, and orange color is distinctive.

### Description of minor worker

*Measurements* (paratype): HL 0.65, HW 0.54, HLA 0.22, SL 0.71, EL 0.15, ML 0.82, PSL 0.12, PMG 0.00, SPL 0.04, PTW 0.11, PPW 0.14, CI 84, SI 130, PSLI 18, PMGI 0, SPLI 6, PPI 125.

Mandible and clypeus smooth and shining; face uniformly foveolate; margin of vertex rounded; occipital carina narrow, visible in full face view; scape with abundant erect setae longer than maximum width of scape; pronotal humerus weakly developed as obtuse prominence; promesonotal groove indistinct; propodeal spines present, large; entire mesosoma foveolate; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with abundant suberect setae longer than maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with abundant erect setae; color orange.

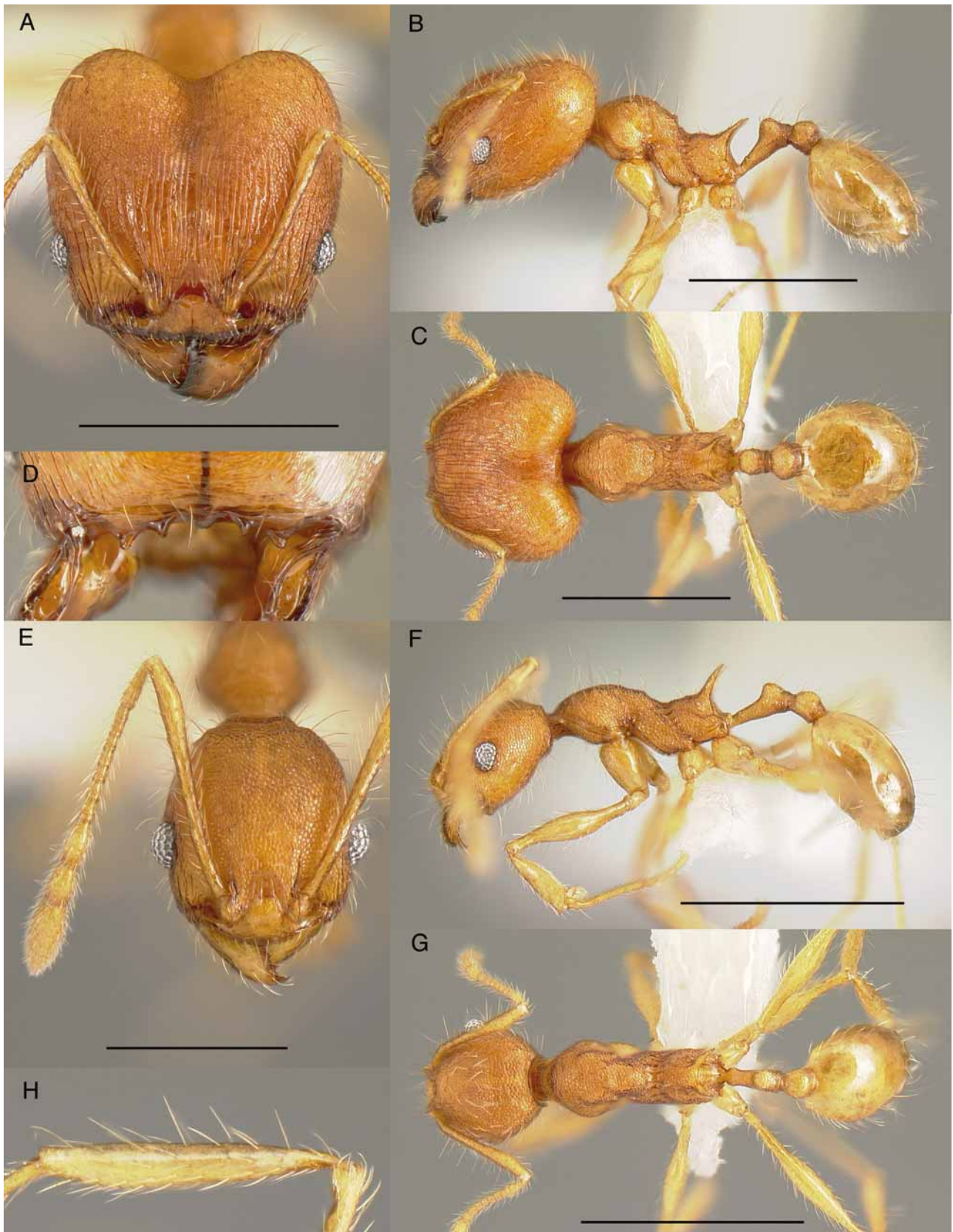
### Description of major worker

*Measurements* (holotype): HL 1.17, HW 1.18, HLA 0.29, SL 0.72, EL 0.18, ML 0.97, PSL 0.23, PMG 0.00, SPL 0.05, PTW 0.17, PPW 0.24, IHT 0.21, OHT 0.40, CI 100, SI 61, PSLI 19, PMGI 0, SPLI 4, PPI 143, HTI 52.

Head cordate; mandible smooth and shiny; clypeus shining, smooth with weak median carina, 2–3 more prominent carinae anterior to frontal carinae, anterior margin straight but with small semicircular impression; face with longitudinal rugae between frontal carina and compound eye and between frontal carinae, rest of face foveolate; head with abundant suberect setae projecting from sides of head in face view; scape smooth and shining or minutely rugulose, terete at base, with abundant erect setae longer than maximum width of scape; hypostomal margin straight; a small blunt median tooth present; inner hypostomal teeth distinct, closer to midline than to outer hypostomal teeth; promesonotal groove indistinct; propodeal spines present, large; mesosoma largely foveolate; dorsal (outer) margin of hind tibia with abundant erect setae, some longer than maximum width of tibia; pilosity abundant on mesosomal dorsum; first gastral tergite smooth and shining, with abundant erect setae; color orange.

### Biology

This species occurs in mid-elevation wet forest. It is known from one collection, a nest under epiphytes in a less than 1-month old treefall.



**FIGURE 6.** *Pheidole epiphyta*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.

## Etymology

The name is in reference to the nesting habits of this species.

## *Pheidole erratilis*

*Pheidole erratilis* Wilson, 2003: 414, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Prov. Alajuela, 3km S Volcan Arenal, 10°26'N 84°42'W, 700m, 17 Feb 1994 (J. Longino) [INBC] (examined).

*Pheidole petersoni* Wilson, 2003: 486, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Prov. Alajuela, Peñas Blancas, 10.300° N 84.751°W, 940m, 24 Jul 1984 (J. Longino) [INBC] (examined). **New synonymy.**

## Geographic Range

Costa Rica.

## Biology

This species occurs in wet forest habitats, from sea level to 1400m elevation. Nests are in rotten wood or dead sticks on or near the forest floor. Workers are occasionally collected in Winkler or Berlese samples, but have not been collected at baits.

## Comments

The types of these two species were collected less than 20km apart and are within the range of variation typical for a single species.

## *Pheidole exarata*

*Pheidole exarata* Emery, 1896: 68. Syntype major, minor worker: Costa Rica, San José: San José [MCSN] (not examined). See also: Wilson, 2003: 686.

*Pheidole crassipes* r. *granta* Forel, 1908: 53. Syntype major, minor worker: Costa Rica, Cartago: Cote Tablazo [a montane site near Cartago] (Biolley) [MHNG] (examined). Wilson, 2003: 700: raised to species. **New synonymy.**

## Geographic Range

Venezuela, Colombia, Costa Rica.

## Biology

*Pheidole exarata* occurs in mature wet forest habitats from 800–1600m elevation. It is arboreal, forming large colonies beneath epiphytes and in live stems. An incipient colony was found in a cavity in a live, 1.5cm diameter stem of a melastomataceous vine; a colony was found in several internodes of a *Cecropia insignis* sapling, another in an internode of *Cecropia angustifolia*; a large aggregation of minor and major workers, but no sexuals or brood, was found in a clean hollow stem of *Neomirandea angularis* (Asteraceae). One colony under epiphytes was observed with multiple dealate queens, evidence of polygyny.

## Comments

The types of *P. granta* closely match the drawings of *P. exarata* in Wilson (2003), the type localities are relatively close, and there is no evidence of distinct sympatric forms of this moderately common species in the central highlands of Costa Rica. *Pheidole exarata* is an upland version of the closely related lowland species, *P. excubitor* Wilson. A third member of this complex is *P. stulta* Forel (the oldest name in the complex). *Pheidole stulta* is similar to *P. excubitor* but with less sculpture on the face of the major and pronotum of the minor (Wilson 2003). Geographic variation is not well understood in these forms and the distinctness of *P. exarata*, *P. excubitor* and *P. stulta* should be further evaluated.



**FIGURE 7.** *Pheidole fossimandibula*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.



## *Pheidole fossimandibula* new species

Figure 7

**Holotype major worker.** Costa Rica, Alajuela: Casa Eladio, Rio Peñas Blancas, 10.31667°N 84.71667°W, ±2000m, 800m, 3 Mar 2008 (J. Longino#6156) [INBC, unique specimen identifier CASENT0608928].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, MEL, UCD, ICN, USNM].

### Geographic Range

Costa Rica.

### Diagnosis

With the morphometric profile and general habitus of *P. bigote* and *P. vestita*. Minor worker: transverse carina on anterior pronotum small and inconspicuous *versus* developed as a prominent flange visible in side view (*bigote*); mandible with basal portion roughened *versus* completely smooth and shining (*vestita*); katapisternum and side of propodeum faintly foveolate and lacking rugulae *versus* with irregular rugulae overlaying foveolate sculpture (*bigote*) or with irregular rugulae (*vestita*). Major worker: mandible with a broad concavity covering basal half of dorsal surface *versus* dorsal surface flat to weakly convex (*bigote*, *vestita*).

### Description of minor worker

*Measurements* (paratype): HL 0.78, HW 0.70, HLA 0.30, SL 0.69, EL 0.15, ML 0.93, PSL 0.03, PMG 0.00, SPL 0.03, PTW 0.12, PPW 0.16, CI 90, SI 99, PSLI 4, PMGI 0, SPLI 4, PPI 135.

*Measurements* (n=10): HL 0.63–0.78, HW 0.60–0.70, SL 0.62–0.69, CI 90–94, SI 99–105.

Mandible with faint rugulose-foveolate sculpture on base of dorsal surface, grading to smooth and shiny at masticatory margin; clypeus smooth and shining; face with about four widely-spaced concentric rugae around antennal insertion, rest of face smooth and shining; posterior margin of vertex somewhat flattened; occipital carina narrow, visible in full face view; scape faintly foveolate, with abundant erect setae longer than maximum width of scape; promesonotum smoothly arched with no trace of promesonotal groove; propodeal spines very short, upturned; promesonotum and anepisternum smooth and shining; katapisternum and lateral and dorsal faces of propodeum generally shining with faint foveolation; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with abundant suberect setae longer than maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with moderately abundant, long erect setae; color dark red brown.

### Description of major worker

*Measurements* (holotype): HL 2.24, HW 1.73, HLA 0.58, SL 0.74, EL 0.22, ML 1.68, PSL 0.11, PMG 0.00, SPL 0.07, PTW 0.33, PPW 0.52, IHT 0.36, OHT 0.62, CI 77, SI 43, PSLI 5, PMGI 0, SPLI 3, PPI 155, HTI 58.

Mandible smooth and shining, with broad concavity covering basal half of dorsal surface, basal margin forming a narrow ridge covered with dense long decumbent yellow setae; clypeus with two median gibbosities, gibbosities and lateral clypeus covered with dense piligerous puncta and long orange-yellow setae that sweep forward and medially, midline of clypeus concave, smooth and shining; frontal carinae forming elevated triangular lamina anteriorly, slanting obliquely outward posteriorly, forming dorsal margins of prominent antennal scrobes, ventral margin of scrobe formed by strong carina, scrobe surface smooth and shining, space between scrobe, compound eye, and clypeus with coarse, widely-spaced carinae; area between frontal carinae smooth and shining, grading to widely-spaced arcuate to reticulate rugae on vertex lobes; face covered with dense erect yellow setae, becoming denser and longer on anterior face and clypeus, in lateral view forming a conspicuous yellow brush anteriorly; head with abundant erect setae projecting from sides of

head in face view; scape microsculptured and dull, not shining, somewhat flattened at base but not broadened, narrower than width at apex, with abundant erect setae longer than maximum width of scape; hypostomal margin straight; median tooth small; inner hypostomal teeth pointed, stout, about one half distance from midline to outer hypostomal teeth; promesonotal groove absent; propodeal spines present; mesosoma largely smooth and shining, with sparse small carinulae; dorsal (outer) margin of hind tibia with abundant suberect setae longer than maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view strongly lenticular, much broader than long; first gastral tergite with small patch of longitudinal etched microsculpture near postpetiolar insertion, smooth and shining elsewhere, with abundant long erect yellowish setae; color dark red brown.

### Biology

This species inhabits mature wet forest from sea level to 800m elevation. Minor workers are relatively common and are frequently collected in Winkler samples, at baits, and in Malaise traps.

Two nests were excavated in close proximity. The nests were located by following minor workers from baits to nest entrances. The nest entrance was a simple hole in the ground, with no superstructure. One excavation reached 10–15cm depth, uncovering two or three chambers with brood, minor workers, and major workers. The second excavation was 12cm deep, uncovering two chambers, one shallower and one at 12cm, also with brood, minors, and majors. No reproductives were found, and it is possible that the nests continued deeper than the zone of excavation. No seeds were found in the uncovered chambers.

The major workers have never been observed leaving the nest and their function in the colony is unknown. Prior to excavating one of the above nests a live *Aphaenogaster* worker was pinned to the ground at the nest entrance. Some minor workers immediately attacked and there was increased activity around the entrance, but after 5 minutes no majors had recruited, and upon excavation I found majors only in the deepest chambers.

### Etymology

The name is in reference to the depression on the dorsal surface of the mandible of the major worker.

### Comments

See under *P. bigote*.

### Additional material examined

COSTA RICA: Heredia, La Selva Biological Station, 10°25'N, 84°01'W, 50m (multiple collectors and collections); 16km SSW Pto. Viejo, 10°19'03"N, 84°02'56"W, 500m (multiple collectors and collections); Cantarrana, 11km ESE La Virgen, 10°20'43"N, 84°03'28"W, 300m (multiple collectors and collections).

### *Pheidole gymnoceras* new species

Figure 8

**Holotype major worker.** Costa Rica, Heredia: 10km NE Vara Blanca, 10.23333°N 84.08333°W, ±2000m, 1500m, 9 Feb 2005 (J. Longino#5412) [INBC, unique specimen identifier INB0003659251].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, MEL, UCD, UNAM, ICN, USNM].

### Geographic Range

Costa Rica.

## Diagnosis

With the morphometric profile of *P. aciculata*, minor workers very similar to the sympatric *P. indagatrix*. Minor worker: scape with all setae shorter than maximum width of scape *versus* with many erect setae longer than maximum width of scape (*aciculata*, *indagatrix*); hind femur with subdecumbent setae on dorsal surface *versus* with suberect setae on dorsal surface (*aciculata*, *indagatrix*). Major worker: relative to *aciculata*, inner hypostomal teeth more widely spaced; mesosoma less shiny; scapes with shorter setae; hind femur with dorsal setae subdecumbent *versus* suberect; sides of head with shorter, less erect setae; posterior margin of head more cordate.

## Description of minor worker

*Measurements* (paratype): HL 0.83, HW 0.63, HLA 0.30, SL 1.17, EL 0.20, ML 1.11, PSL 0.10, PMG 0.04, SPL 0.04, PTW 0.13, PPW 0.19, CI 76, SI 185, PSLI 12, PMGI 5, SPLI 5, PPI 150.

*Measurements* (n=9): HL 0.78–0.85, HW 0.59–0.65, SL 1.10–1.17, CI 74–77, SI 176–190.

Mandible and clypeus smooth and shining; face with a few concentric rugae around antennal insertion, small patch of foveolate sculpture between frontral carina and compound eye; rest of face smooth and shining; margin of vertex rounded; occipital carina narrow, visible in full face view; scape with dense suberect setae but all shorter than maximum width of scape; promesonotal groove present, conspicuous; propodeal spines present; pronotum with patches of foveolate sculpture on humerus and anterior border, smooth and shining elsewhere; katepisternum and lateral and dorsal faces of propodeum foveolate overlain with inconspicuous rugulae; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with abundant suberect setae, some longer than maximum width of tibia; dorsal face of hind tibia with setae appressed to subdecumbent; first gastral tergum smooth and shining; gastral dorsum with abundant suberect setae; color red brown.

## Description of major worker

*Measurements* (holotype): HL 1.42, HW 1.39, HLA 0.40, SL 1.07, EL 0.24, ML 1.43, PSL 0.08, PMG 0.04, SPL 0.06, PTW 0.26, PPW 0.34, IHT 0.50, OHT 0.57, CI 98, SI 77, PSLI 6, PMGI 3, SPLI 4, PPI 130, HTI 88.

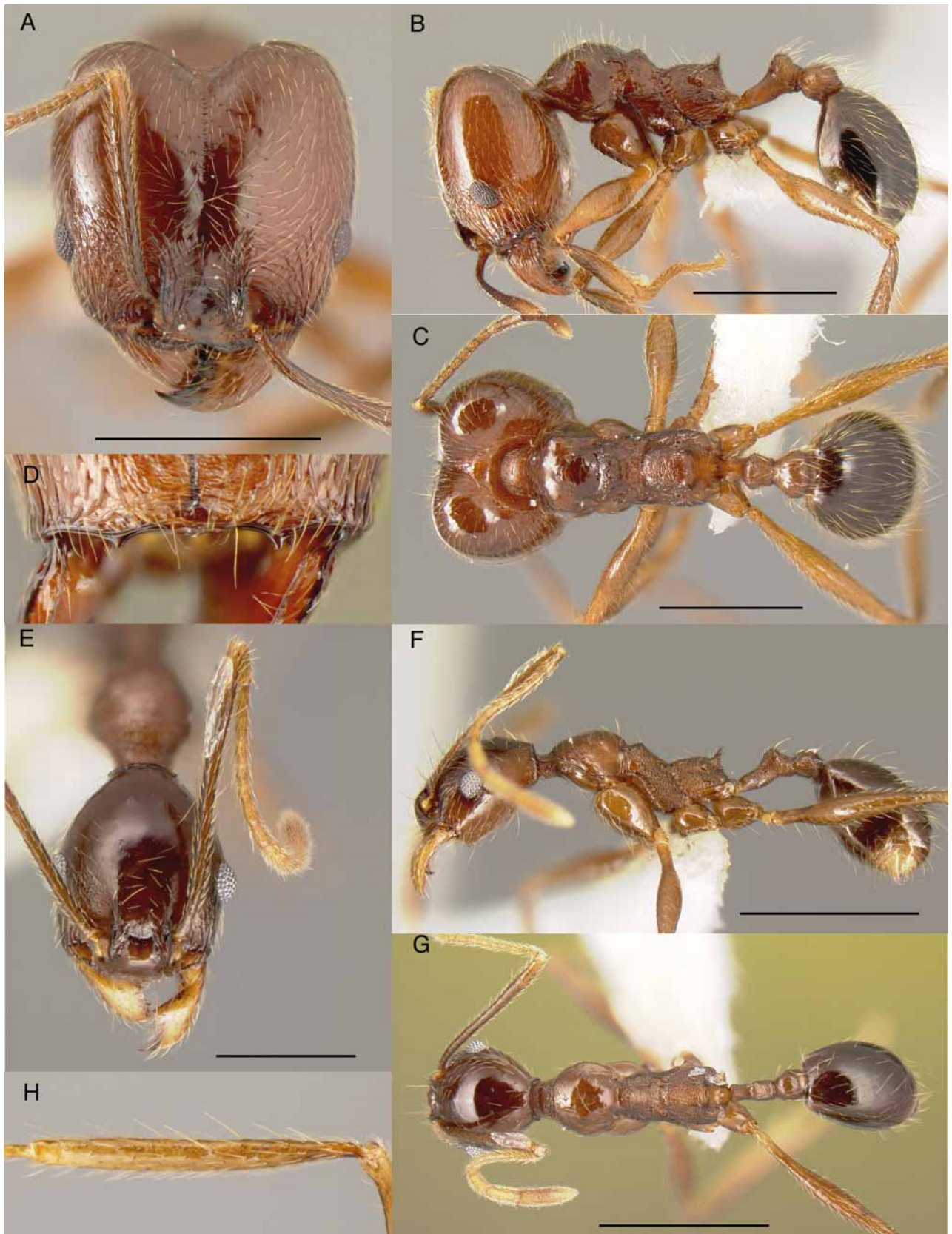
Mandible smooth and shiny; clypeus smooth and shining, flat, with distinct anterior notch; short longitudinal rugae between mandibular insertion and compound eye, a few concentric rugae around antennal insertion, grading to reticulate rugae between frontal carina and compound eye, rest of face smooth and shining; head with abundant short subdecumbent setae projecting from sides of head in face view; scape smooth and shining, terete at base, with abundant short subdecumbent setae, none longer than maximum width of scape; hypostomal margin straight; median tooth absent; inner hypostomal teeth thin and sharp, widely-spaced, much closer to outer hypostomal teeth than to midline; promesonotal groove present; propodeal spines present; pronotum smooth and shining with small irregular patches of faint foveolate sculpture; katepisternum smooth and shining anteriorly, grading to rugose-foveolate posteriorly and on lateral and dorsal faces of propodeum; dorsal (outer) margin of hind tibia with abundant suberect setae, some longer than maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view globular; first gastral tergite smooth and shining, with abundant suberect setae; color red brown.

## Biology

This species inhabits mid-elevation wet forest. During ALAS project sampling of the Barva transect it was found at the 1100m and 1500m sites. At the 1100m site it was most frequently captured in flight intercept traps, suggesting it is an epigaeic forager. At the 1500m site (Finca Murillo) a small queenrite nest was found beneath rotten wood; the workers had a foetid odor.

## Etymology

The name is in reference to the lack of longer erect setae on the scape of the minor worker.



**FIGURE 8.** *Pheidole gymnoceras*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.

### Additional material examined

COSTA RICA: Heredia, 16km SSE La Virgen, 10°16'N, 84°05'W, 1100m (multiple collectors and collections).

### *Pheidole harrisonfordi*

*Pheidole harrisonfordi* Wilson, 2003: 433, figs. Holotype major worker and associated paratype minor worker: Honduras, Depto. Santa Barbara, El Sauce, 700m, Mar 1979, steep, rocky forest slope, rotten wood (W. L. Brown) [MCZ] (examined).

*Pheidole ruida* Wilson, 2003: 499, figs. Holotype major worker and associated paratype minor worker: Panama, Canal Zone, Barro Colorado Island, Jan 1960 (W. L. Brown & E. S. McCluskey) [MCZ] (examined). **New synonymy.**

*Pheidole prolixa* Wilson, 2003: 488, figs. Holotype major worker and associated paratype minor worker: Mexico, Veracruz, Los Tuxtlas, 10km NNW Sontecomapan, 18°35'N 95°05'W, 200m, 20 Mar 1985, sifted litter, rainforest (P. S. Ward 7333-49), [MCZ] (examined). **New synonymy.**

*Pheidole tenebra* Wilson, 2003: 519, figs. Holotype major worker and associated paratype minor worker: Mexico, Veracruz, Cordoba, Paraje Nuevo, Nacimiento, 7 Aug 1969, tropical evergreen forest, Berlese 176 (S. & J. Peck) [MCZ] (examined). **New synonymy.**

### Geographic Range

Panama to southern Mexico.

### Biology

This species occurs in wet forest habitats, from sea level to 1800m elevation. It is often one of the most abundant species in Winkler or Berlese samples of forest floor litter, and may also recruit to baits. In spite of its abundance in Winkler samples, I have never encountered a nest.

### Comments

The leaf litter of Central American wet forest is filled with small, dark-colored *Pheidole* that share the following characters: *minor worker*: HW 0.36–0.47, SI 84–92; promesonotal groove not impressed, promesonotum forming a single convexity, dorsal profile of promesonotum subrectangular, not evenly arched; propodeal spines present, short, upturned; dorsal surface of head and entire mesosoma with foveolate sculpture, sometimes overlain with rugulae, never with smooth shiny areas; dorsal surface of first gastral tergite smooth and shining; standing pilosity moderately abundant on head, mesosomal dorsum, and gastral dorsum; hind tibia usually with decumbent short pilosity of uniform length, some populations with 2–3 somewhat longer suberect setae; *major worker*: HW 0.65–1.00, SI 40–60; mandible and clypeus smooth and shining; hypostomal margin with strongly-developed inner teeth close to midline; face densely and coarsely foveolate throughout, overlain with longitudinal rugulae between frontal carinae and a dense reticulum of rugulae on the rest of the posterior half or more of face, these rugulae completely mesh-like, not parallel, and the sculpture extending all the way to the vertex lobes, with no shiny portions of posterior vertex lobes; postpetiole in dorsal view strongly transverse, with well-developed acute projecting conules; gastral dorsum smooth and shiny; pilosity as in minor worker.

Within this morphological envelope there is wide variation in details of major worker head size and shape, and in the minor worker there is variation in size and the degree of development of irregular rugulae on the face and particularly on the promesonotum. In some cases there appear to be discrete forms in sympatry, and this "species" will almost certainly resolve into multiple cryptic species. There are some morphological patterns that occur over elevational gradients (montane forms tend to have major workers with larger and proportionally longer heads) and over horizontal distance (material from Panama and Costa Rica's southern Pacific coast looks slightly different from material from Costa Rica's Atlantic slope, which looks slightly different from material from southern Mexico).

The types of Wilson's *P. harrisonfordi*, *P. ruida*, *P. prolixa*, and *P. tenebra* are very similar. Their measurements fall very close to each other among the larger spread of measurements in the complex as a

whole. They match the dominant, somewhat uniform lowland form of *P. harrisonfordi*, and not the most conspicuous variants, which tend to be mid-elevation or montane. These names could come out of synonymy with further resolution of the complex, but at this point there are no morphological grounds for separating them.

### *Pheidole innupta*

*Pheidole innupta* Menozzi, 1931: 200, fig. 7. Syntype major, minor worker, gyne: Costa Rica, Vara Blanca (Schmidt) [DEIB] (examined). Wilson, 2003: 165: junior synonym of *P. alfaroi*. **Revived status.**

### Geographic Range

Costa Rica.

### Biology

This species occurs only in cloud forest habitats, where it nests in large epiphyte mats in the canopy, and occasionally in dead wood near ground level. Foundress queens occur under epiphyte mats, and in some cases pleometrosis occurs (a group of over five queens together with brood and small workers has been observed). Colonies are large, with many workers pouring forth when the nest is disturbed. Soldiers tend to stay deep within the colony. The feeding habits of this species are unknown. Foragers have never been observed outside of the nests. Observations have been almost entirely during the day, so they could forage nocturnally. Alternatively, they may have specialized and perhaps plant-derived food sources within the nests. Scattered mealybugs may be found on epiphyte roots in the nests.

### Comments

*Pheidole innupta* and *Pheidole alfaroi* appear identical with respect to size, shape, surface sculpture, and pilosity. They differ in color, distribution, and nesting behavior. It is common in ant taxonomy to disregard color as a species specific trait because it often varies intraspecifically, especially in polytypic species with allopatric or parapatric color forms. But in this case the two species appear to remain distinct in sympatry, with very little evidence of intergradation.

Both species are so far only known from Costa Rica, although similar montane species occur in the mountains of Colombia. *Pheidole innupta* workers are dark brown to black; *P. alfaroi* workers are light orange brown. *Pheidole innupta* occurs in cloud forest habitats in the northern cordilleras of Costa Rica, from the Cordillera Volcanica Central to the Cordillera de Guanacaste. *Pheidole alfaroi* is only known from the Cordillera Volcanica Central. *Pheidole innupta* occurs in heavily forested areas, nesting under thick epiphyte mats either in the canopy or in gaps where epiphyte-laden branches have fallen. *Pheidole alfaroi* occurs more on the ground, either under second growth forest or in cloud forest pastures, nesting under dead wood.

In the Project ALAS quantitative sampling along the Barva Transect in Costa Rica, intensive sampling was carried out at 1100m, 1500m, and 2000m elevation. The 1100m site was all dense primary forest. The 1500m site was an ecotone between primary forest and actively maintained cow pastures. The 2000m site was a mosaic of primary forest and regenerating second growth vegetation. Ants were collected using Winkler samples of sifted litter from the forest floor, flight intercept traps, and Malaise traps. At the 1100m site, *P. alfaroi* was moderately abundant in all sample types, while *P. innupta* was rare, occurring in only one of 20 Malaise traps. At the 1500m site *P. alfaroi* was one of the most abundant ants, occurring in all sample types and in many hand collections of nests under dead wood, and *P. innupta* was absent. At the 2000m site, *P. innupta* workers were collected occasionally in Malaise traps and flight intercept traps, but never in Winkler samples from the forest floor litter. *Pheidole alfaroi* was absent. These observations suggest that *P. innupta* and *P. alfaroi* are ecological replacements, with *P. innupta* being arboreal and adapted to the coldest conditions and highest elevations, while *P. alfaroi* is ground-nesting and adapted to slightly warmer, lower

elevation, and/or more disturbed habitats. This is an interesting species pair to observe with respect to climate change.



**FIGURE 9.** *Pheidole janzeni*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for A, E, F, G, 1mm for others.

## *Pheidole janzeni* new species

Figure 9

*Pheidole mackayi* Wilson, 2003 (part, image and description of minor worker).

**Holotype major worker.** Costa Rica, Guanacaste: Santa Rosa National Park, Sector Murcielago campground, 10.90092°N 85.72943°W, ±100m, 50m, 27 Feb 2008 (J. Longino#6144.04) [INBC, unique specimen identifier CASENT0608973].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, UCD, ICN, USNM].

### Geographic Range

Costa Rica, Guatemala, Mexico (Chiapas).

### Diagnosis

The morphometric profile of *Pheidole janzeni* is unique. The extremely small minor workers have the habitus of *P. laselva* and *P. nigricula*, differing from those in the more extensive foveolate sculpture on the katepisternum and propodeum, and the shorter propodeal spines. The major worker differs from those species in the presence of shallow, smooth antennal scrobes surrounded by reticulate rugose sculpture.

### Description of minor worker

*Measurements* (paratype): HL 0.43, HW 0.39, HLA 0.11, SL 0.33, EL 0.10, ML 0.48, PSL 0.00, PMG 0.00, SPL 0.02, PTW 0.07, PPW 0.10, CI 91, SI 84, PSLI 0, PMGI 0, SPLI 5, PPI 154.

*Measurements* (n=6): HL 0.40–0.44, HW 0.36–0.40, SL 0.32–0.36, CI 90–91, SI 84–95.

Face smooth and shining; margin of vertex flattened with median impression; occipital carina narrow, not visible in full face view; scape with abundant suberect setae about as long as maximum width of scape; promesonotal groove absent; propodeal spines reduced to short obtuse angles; lateral face of pronotum and entire promesonotal dorsum smooth and shining; anepisternum foveolate; katepisternum with medial shiny area surrounded by foveolae; dorsal face of propodeum foveolate, posterior face smooth and shining, lateral face foveolate dorsally, smooth and shining ventrally; mesosomal dorsum with 8–12 medium-length clear (not black) erect setae; dorsal (outer) margin of hind tibia with short decumbent pilosity, no long erect hairs; first gastral tergum smooth and shining; gastral dorsum with moderately abundant, somewhat stiff erect setae; color dark brown to black.

### Description of major worker

*Measurements* (holotype): HL 0.74, HW 0.62, HLA 0.15, SL 0.32, EL 0.10, ML 0.62, PSL 0.01, PMG 0.00, SPL 0.03, PTW 0.11, PPW 0.18, IHT 0.12, OHT 0.24, CI 83, SI 52, PSLI 1, PMGI 0, SPLI 4, PPI 156, HTI 50.

*Measurements* (n=4): HL 0.73–0.81, HW 0.60–0.66, SL 0.32–0.36, CI 82–83, SI 51–57.

Mandibles smooth and shiny with 3–4 coarse, widely-separated longitudinal rugae on outer base, moderately abundant subdecumbent setae on dorsal surface; clypeus smooth and flat with shallow anterior notch; face with well-defined shallow antennal scrobes, medial area somewhat swollen, sloping to relatively depressed vertex lobes, scrobes smooth and shining, most of rest of face with reticulate rugose sculpture, extending to posterior margin of vertex, about 4 stronger longitudinal rugae on frontal space posterior to clypeus; in face view anterolateral margins of head slightly flaring at mandibular condyles; head with abundant short suberect setae projecting from sides of head in face view; scape smooth and shining, terete, with abundant erect setae longer than maximum width of scape; hypostomal margin gently curved; median tooth an inconspicuous short nub; inner hypostomal teeth small but distinct, slightly closer to midline than to outer hypostomal teeth; promesonotal groove absent, dorsal profile of promesonotum evenly arched;



propodeal spines present, short; promesonotum smooth and shining with patch of foveolae and rugae on humeral angles; remaining mesosomal sculpture as in minor worker; dorsum of postpetiole smooth and shining; dorsal (outer) margin of hind tibia with short decumbent pilosity, no long erect hairs; pilosity abundant on mesosomal dorsum; first gastral tergite smooth and shining, with abundant erect setae; color dark brown.

### Biology

*Pheidole janzeni* occurs in dry forest habitats. In Costa Rica, minor and major workers were collected at baits near a stream edge. Similarly, minor and major workers were collected at baits in dry forest localities in Chiapas, Mexico. Habitats have been open dry areas with frequent disturbance, including a recently slashed and burned field, and an area of heavy livestock use. An isolated minor worker was collected in pine oak forest at 1100m in Guatemala. It is likely that this species is common and widespread in seasonally dry areas of Mesoamerica but has been largely overlooked due to its small size.

### Etymology

This species is named for an important mentor of mine, D. H. Janzen. It may seem odd to name such a diminutive species for a giant in tropical ecology, but (1) it is a distinctive species, unlikely to be synonymized, (2) it is widespread in synanthropic habitats, and thus likely to be frequently encountered for generations to come, and (3) it is found in tropical dry forest habitats, the conservation of which Janzen has championed.

### Comments

The type series of *P. mackayi* was from a bait and is a mixed series, with the minor workers being this newly described species and not conspecific with the holotype major worker of *P. mackayi*. The collections from Costa Rica and Mexico are remarkably similar and appear identical in every respect; they show no geographic variation.

### Additional material examined

GUATEMALA: Zacapa, 8.5km NE Tuculután, 15°03'31"N, 89°40'35"W, 1100m (M. Branstetter); MEXICO: Chiapas, Sierra Morena, 16°09'15"N, 93°35'23"W, 1150m (J. Longino); 24km SW Cintalapa, 16°32'N, 93°53'W, 710m (W. MacKay).

### *Pheidole karolmorae* new species

Figure 10

**Holotype major worker.** Costa Rica, Heredia: La Selva, 8km SW Pto. Viejo, 10.40000°N 84.05000°W, ±2000m, 150m, 17 Jul 1986 (J. Longino#1391-s) [INBC, unique specimen identifier INBIOCRI002279843].

**Paratypes:** major and minor workers. Same data as holotype; same locality as holotype but 14 Oct 1991 (J. Longino#3077-s, #3078-s), 2 Jul 1992 (J. Longino#3203-s) [FMNH, INBC, JTLC, MCZ, UCD, USNM].

### Geographic Range

Costa Rica.

### Diagnosis

With the morphometric profile of a large number of small *Pheidole*: *ademonia* Wilson 2003, *arhuaca* Forel 1901, *cardiella* Wilson 2003, *constipata* Wheeler 1908, *darlingtoni* Wheeler 1936, *flavens* Roger 1863, *funki* LaPolla 2005, *harrisonfordi* Wilson 2003, *karolsetosa* (new species in this work), *micridris* Wilson 2003, *meinertopsis* Wilson 2003, *oaxacana* Wilson 2003, *sabella* Wilson 2003, *sculptior* Forel 1893. **Minor worker:** head relatively broad, CI about 97, *versus* head relatively narrow, CI 88–93 (*flavens*); clypeus

punctate *versus* smooth and shining (*harrisonfordi*); promesonotum somewhat box-like and dropping abruptly to metanotal groove *versus* more evenly arched (*ademonia*) or box-like but not dropping as abruptly to metanotal groove (*flavens*, *harrisonfordi*, *oaxacana*); promesonotal humeri not at all produced *versus* relatively more developed (*oaxacana*); promesonotal groove completely absent *versus* weakly impressed (*meinertopsis*); side of pronotum and katapisternum uniformly and strongly foveolate *versus* faintly foveolate to smooth and shining (*ademonia*); pilosity of mesosomal dorsum and first gastral tergite moderately abundant *versus* relatively sparser and more regular (*ademonia*, *constipata*); petiolar node relatively robust, proportionately large relative to anterior petiolar peduncle, apex fully foveolate, *versus* petiolar node smaller, proportionately smaller relative to anterior peduncle, apex smooth and shiny (*harrisonfordi*, *oaxacana*); dorsal (outer) margin of hind tibia with short decumbent pilosity only, no long erect hairs, *versus* with three or more long erect setae on dorsal surface of hind tibia, longer than maximum width of tibia and differentiated from underlying shorter subdecumbent pubescence (*karolsetosa*, *oaxacana*); color uniformly orange brown *versus* bicolored, mesosoma light yellow white, head and gaster darker (*darlingtoni*, endemic to Haiti). **Major worker:** head in lateral view deep, with strongly convex dorsal surface, *versus* head relatively flatter in lateral view, with less convex dorsal surface (*constipata*, *flavens*, *harrisonfordi*); head with moderately convex sides and posterior margin shallowly emarginate *versus* with more convex sides and more strongly cordate posterior margin (*cardiella*); inner hypostomal teeth present *versus* absent (*micridris*); face rugose foveolate throughout, rugae reticulate on posterior half, *versus* posterior face more coarsely rugose with shiny interspaces (*ademonia*) or vertex lobes smooth and shiny (*arhuaca*, *sabella*) or vertex lobes more uniformly foveolate with reduced rugulation (*meinertopsis*); antennal scrobe absent *versus* weakly developed (*ademonia*, *cardiella*, *flavens*, *sculptior*) or strongly developed (*funki*); pilosity on dorsal surface of mandible relatively abundant, long, suberect, *versus* sparse, short, fully appressed (*ademonia*); foveolate sculpture of face wrapping around onto ventral surface of head *versus* posteroventral portion of head capsule smooth and shiny (*ademonia*); face uniformly red brown *versus* orange with medial dark brown spot (*oaxacana*); promesonotum somewhat box-like and dropping abruptly to metanotal groove *versus* more evenly arched (*ademonia*) or box-like but not dropping as abruptly to metanotal groove (*flavens*); promesonotal groove completely absent *versus* weakly impressed (*meinertopsis*, *sabella*); side of pronotum foveolate *versus* smooth and shiny (*ademonia*, *arhuaca*); postpetiole in dorsal view trapezoidal *versus* strongly transverse and conulate (*harrisonfordi*); pilosity of mesosomal dorsum and first gastral tergite moderately abundant *versus* relatively sparser and more regular (*constipata*); dorsal (outer) margin of hind tibia with short decumbent pilosity only, no long erect hairs, *versus* with three or more long erect setae on dorsal surface of hind tibia, longer than maximum width of tibia and differentiated from underlying shorter subdecumbent pubescence (*karolsetosa*, *oaxacana*).

### Description of minor worker

*Measurements* (paratype): HL 0.38, HW 0.38, HLA 0.10, SL 0.31, EL 0.09, ML 0.40, PSL 0.04, PMG 0.00, SPL 0.02, PTW 0.08, PPW 0.11, CI 99, SI 83, PSLI 10, PMGI 0, SPLI 5, PPI 139.

*Measurements* (n=11): HL 0.38–0.42, HW 0.36–0.40, SL 0.31–0.38, CI 90–99, SI 83–103.

Clypeus foveolate; face uniformly foveolate; margin of vertex rounded with median impression; occipital carina narrow, not visible in full face view; scape with abundant erect setae longer than maximum width of scape; promesonotal groove absent; propodeal spines present; entire mesosoma foveolate; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with short decumbent pilosity, no long erect hairs; first gastral tergum smooth and shining; gastral dorsum with moderately abundant, somewhat stiff setae; color orange.

### Description of major worker

*Measurements* (holotype): HL 0.76, HW 0.74, HLA 0.15, SL 0.37, EL 0.10, ML 0.53, PSL 0.07, PMG 0.00, SPL 0.04, PTW 0.12, PPW 0.17, IHT 0.14, OHT 0.26, CI 97, SI 51, PSLI 10, PMGI 0, SPLI 5, PPI 143, HTI 52.



**FIGURE 10.** *Pheidole karolmorae*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bars 0.5mm.

*Measurements* (n=9): HL 0.74–0.83, HW 0.70–0.80, SL 0.37–0.44, CI 93–99, SI 51–55.

Head in lateral view deep, with strongly convex dorsal surface; mandible smooth and shiny; clypeus smooth and flat with shallow anterior notch; face rugose foveolate throughout; rugae reticulate on posterior half, increasingly longitudinal and subparallel on anterior half; head with abundant suberect setae projecting from sides of head in face view; scape smooth and shining, terete at base, with abundant erect setae longer than maximum width of scape; hypostomal margin gently curved; median tooth small; inner hypostomal teeth pointed, stout, about one half distance from midline to outer hypostomal teeth; promesonotal groove absent; propodeal spines present; mesosoma largely foveolate; dorsal (outer) margin of hind tibia with short decumbent pilosity, no long erect hairs; pilosity abundant on mesosomal dorsum; first gastral tergite smooth and shining or with variable extent of faint, patchy foveolae near postpetiolar insertion, with abundant flexuous erect setae; color orange brown.

## Biology

*Pheidole karolmora* occurs throughout Costa Rica in lowland wet forest habitats, from sea level to 800m. It is known exclusively from Winkler and Berlese samples of forest floor leaf litter; the nest is unknown. Major and minor workers are found in litter samples, and one dealate queen has been tentatively associated with workers. The species is relatively common at La Selva Biological Station and nearby Braulio Carrillo National Park, occurring in many litter samples. However, it has never been collected at a bait, in spite of abundant baiting samples from La Selva. This suggests that it is strongly restricted to foraging in and under the litter.

## Etymology

This species is named for Karol Mora. Karol worked for several years with Conservation International's TEAM project at La Selva Biological Station, during the time when the project was sampling litter ants as a means of assessing and monitoring biotic response to climate change. Karol was solely responsible for processing the litter samples for ants. Her keen observational skills, ability to recognize hundreds of ant species, and unflagging dedication to the project resulted in a dataset and ant collection that is a major contribution to our knowledge of Neotropical ant communities.

## Additional material examined

COSTA RICA: Alajuela, Casa Eladio, Rio Penas Blancas, 10°19'N, 84°43'W, 800m (J. Longino, multiple collections); Heredia, La Selva Biological Station, 10°25'N, 84°01'W, 50m (many collectors, multiple collections); 16km SSW Pto. Viejo, 10°19'N, 84°03'W, 500m (many collectors, multiple collections); Cantarrana, 11km ESE La Virgen, 10°21'N, 84°03'W, 300m (many collectors, multiple collections); 17km N Vol. Barba, 10°17'N, 84°05'W, 800m (many collectors, multiple collections); Limón, Hitoy Cerere Biol. Reserve, 09°40'N, 83°02'W, 200m (J. Longino); Puntarenas, Bijagual, Carara Biol. Reserve, 9°47'N, 84°36'W, 500m (J. Longino); Rancho Quemado, Osa Peninsula, 8°42'N, 83°33'W, 200m (J. Longino).

## *Pheidole karolsetosa* new species

Figure 11

**Holotype major worker.** Costa Rica, Heredia: 16km SSW Pto. Viejo, 10.31750°N 84.04889°W, ±500m, 500m, 20 Apr 2007 (Marcos M and Deimer A#AMI-3-W-136-06) [INBC, unique specimen identifier CASENT0609023].

**Paratypes:** major and minor workers. Same data as holotype; same locality as holotype but 18 Oct 2005 (Marcos M, Gilbert H, and Felix C#AMI-3-W-053-03), 11 Jul 2006 (Gilbert H and Johanna H#AMI-3-W-085-05), 16 Oct 2006 (Marcos M and Deimer A#AMI-3-W-099-01 and AMI-3-W-099-08), 6 Feb 2007 (Marcos M and Deimer A#AMI-3-W-120-04); Costa Rica, Heredia: 11km SE La Virgen, 10.33333°N

84.06667°W, ±2000m, 500m, 15 Mar 2003 (ALAS#05/WF/03/39); Costa Rica, Heredia: Cantarrana, 11km ESE La Virgen, 10.34528°N 84.05778°W, ±500m, 300m, 21 Mar 2006 (Marcos M, Gilberth H, Felix C#AMI-4-W-068-03); Costa Rica, Heredia: La Selva, 8km SW Pto. Viejo, 10.40000°N 84.05000°W, ±2000m, 150m, 17 Jul 1986 (J. Longino#JTL1391-s) [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, MEL, UCD, ICN, USNM].

## Geographic Range

Costa Rica.

## Diagnosis

Very similar to the sympatric *P. karolmora*; also can be confused with the sympatric *P. specularis*. See under *P. karolmora* for diagnostic differences from species other than *P. karolmora* and *P. specularis*. **Minor worker**: side of petiole and postpetiole strongly foveolate *versus* weakly foveolate (*specularis*); propodeal spines relatively short, PSLI 14, *versus* longer, PSLI 15–19 (*specularis*); postpetiole in dorsal view oval *versus* more trapezoidal (*specularis*); dorsal face of hind tibia with three or more long erect setae that are longer than maximum width of tibia and differentiated from underlying shorter subdecumbent pubescence *versus* with short appressed pubescence only, lacking long erect setae (*karolmora*). **Major worker**: vertex lobes uniformly foveolate *versus* with reticulate rugulae overlying foveolate sculpture (*karolmora*) or less dense and less uniform foveolation (*specularis*); head relatively rectangular and weakly impressed posteriorly *versus* more cordate, with more convex sides and more excavate posterior margin (*karolmora*); postpetiole in dorsal view relatively trapezoidal *versus* more transverse, with well-developed conules (*specularis*); tibial pilosity difference from *karolmora* as in minor worker.

## Description of minor worker

Measurements (paratype): HL 0.44, HW 0.42, HLA 0.13, SL 0.35, EL 0.09, ML 0.45, PSL 0.06, PMG 0.00, SPL 0.03, PTW 0.09, PPW 0.11, CI 94, SI 85, PSLI 14, PMGI 0, SPLI 6, PPI 120.

Measurements (n=7): HL 0.39–0.44, HW 0.38–0.43, SL 0.33–0.37, CI 94–99, SI 84–89.

Differing from *P. karolmora* only in the diagnostic characters above.

## Description of major worker

Measurements (holotype): HL 0.85, HW 0.78, HLA 0.18, SL 0.41, EL 0.11, ML 0.58, PSL 0.08, PMG 0.00, SPL 0.03, PTW 0.13, PPW 0.20, IHT 0.14, OHT 0.28, CI 92, SI 53, PSLI 10, PMGI 0, SPLI 4, PPI 158, HTI 51.

Measurements (n=9): HL 0.77–0.85, HW 0.75–0.80, SL 0.38–0.41, CI 92–98, SI 50–54.

Differing from *P. karolmora* only in the diagnostic characters above.

## Biology

*Pheidole karolsetosa* occurs in mature wet forest leaf litter. It is known only from Winkler samples of leaf litter from 300–500m elevation on the Barva Transect in Braulio Carrillo National Park.

## Etymology

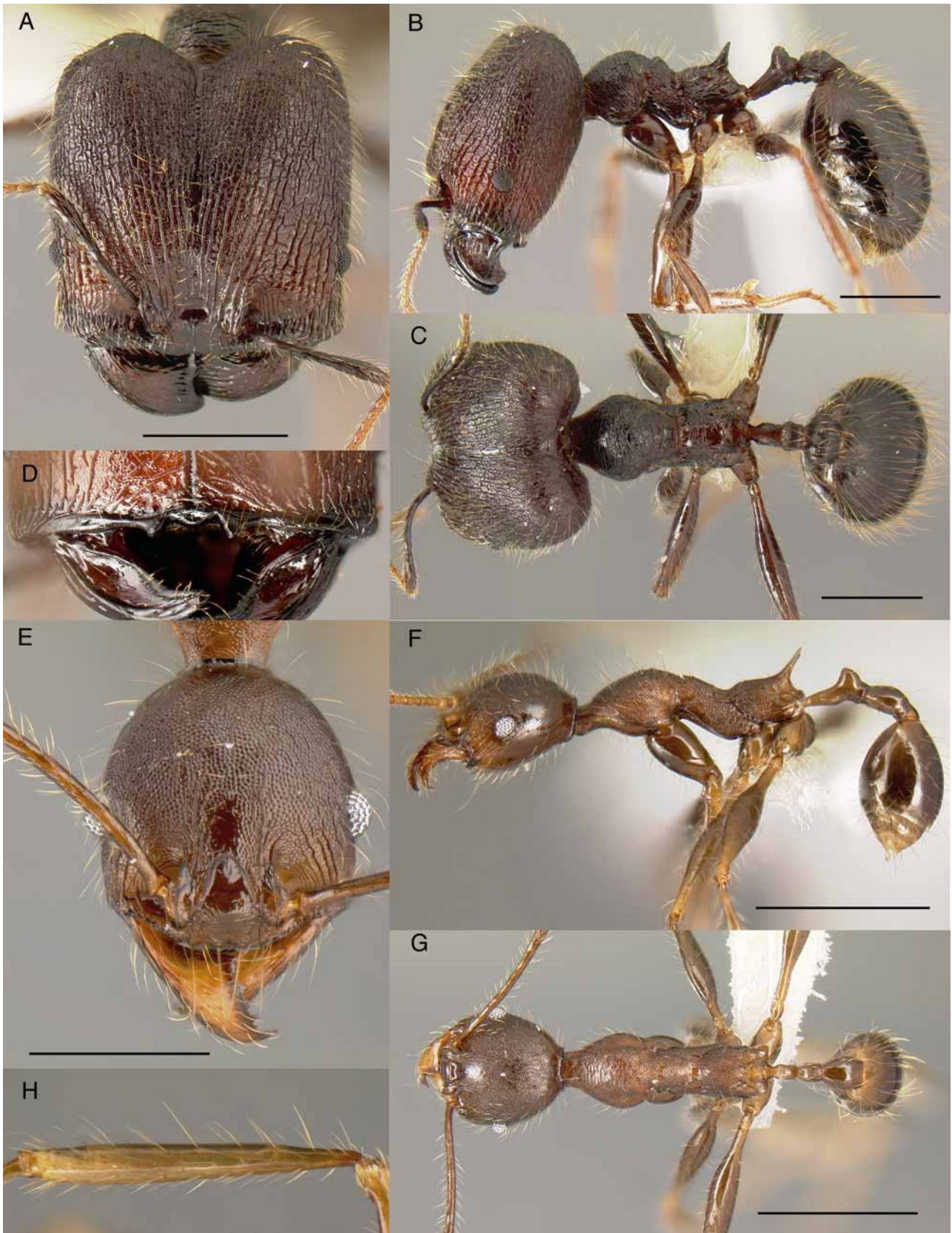
The name is in reference to the similarity to *P. karolmora*, but with long setae on the hind tibia.

## Comments

This species is very similar to *P. karolmora*, differing in characters that are not typically considered sufficient to recognize distinct species. However, the two species are sympatric at the smallest spatial scales and show no overlap in the diagnostic characters.



**FIGURE 11.** *Pheidole karolsetosa*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–D, Holotype major worker; E–H, Paratype minor worker. Scale bar 1.0mm for B, C, 0.5mm for others.



**FIGURE 12.** *Pheidole lagunculinoda*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–D, Paratype major worker; E–H, Holotype minor worker. Scale bar 0.5mm for E, 1mm for others.

## *Pheidole lagunculinoda* new species

Figure 12

**Holotype minor worker.** Mexico, Chiapas: 21km SW Salto de Agua, 17.38542°N 92.42802°W, ±200m, 180m, 15 Jun 2008 (LLAMA#Ba-A-08-4-03-17) [UNAM, unique specimen identifier CASENT0609878].

**Paratypes:** major and minor workers. Same data as holotype; same data as holotype but LLAMA#Ba-A-08-3-02-16, Ba-A-08-4-03-08; Mexico, Chiapas: 8km SE Salto de Agua, 17.51427°N 92.29486°W, ±200m, 70m, 16 Jun 2008 (LLAMA#Ba-A-08-1-01-13, Ba-A-08-1-02-02, -11, -17, -19) [BMNH, CAS, EAPZ, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, UCD, ICN, USNM].

### Geographic Range

Mexico (Chiapas).

### Diagnosis

With a unique morphometric profile. Minor worker: the most distinctive character is the postpetiole, which is much longer than wide in dorsal view and flask-shaped. The postpetiole shape combined with large size and foveolate face should distinguish it from all other species. Major worker: head subrectangular *versus* with sides more convex and posterior margin more cordate (*bulliceps*, *galba*, *gigas*, *hirsuta*, *huacana*); vertex lobes foveolate overlain by reticulate rugulae *versus* with arcing subparallel rugae (*arcifera*, *rhea*) or relatively smooth and shining (*astur*, *auropilosa*, *bergi*, *geraesensis*, *huacana*, *oxyops*, *trageri*); base of scape terete *versus* flattened (*claviscapa*); propodeal spines long *versus* short (*tigris*, *trageri*); first gastral tergite shallowly foveolate anteriorly, grading to smooth and shining posteriorly, *versus* more uniformly foveolate, opaque (*vorax*).

### Description of minor worker

*Measurements* (holotype): HL 0.87, HW 0.73, HLA 0.34, SL 1.20, EL 0.15, ML 1.25, PSL 0.20, PMG 0.01, SPL 0.04, PTW 0.13, PPW 0.23, CI 84, SI 164, PSLI 24, PMGI 1, SPLI 4, PPI 182.

*Measurements* (n=10): HL 0.82–0.90, HW 0.72–0.80, SL 1.10–1.28, CI 84–89, SI 152–167.

Mandible longitudinally striate basally, grading to smooth and shining near masticatory margin; clypeus weakly foveolate rugulose; face shallowly foveolate; margin of vertex rounded; occipital carina well developed as a distinct flange, visible in full face view; scape with abundant erect setae, longest subequal in length to maximum width of scape; promesonotal groove weakly impressed, indistinct; propodeal spines present, long; entire mesosoma foveolate, overlain with weak transverse rugulae on promesonotal dorsum; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with abundant erect setae, longest longer than maximum width of tibia; postpetiole in dorsal view much longer than wide, flask-shaped, tapering anteriorly; first gastral tergum smooth and shining; gastral dorsum with abundant erect setae; color brown.

### Description of major worker

*Measurements* (paratype): HL 2.31, HW 2.16, HLA 0.59, SL 1.16, EL 0.25, ML 1.76, PSL 0.30, PMG 0.04, SPL 0.07, PTW 0.32, PPW 0.66, IHT 0.42, OHT 0.95, CI 93, SI 54, PSLI 13, PMGI 2, SPLI 3, PPI 205, HTI 44.

Mandible with coarse longitudinal striae basally, grading to smooth and shining over most of dorsal surface, dorsal surface with medium density of large puncta, puncta lacking setae (or with very short appressed setae) over most of dorsal surface; clypeus shining, with median carinule, 3–4 longitudinal carinules beneath each frontal carina, weakly wrinkled elsewhere; entire face foveolate overlain by reticulate rugulae, rugulae becoming coarser and more longitudinally parallel anteriorly and between frontal carinae; scrobe absent; basal half of scape strongly curved, scape terete, irregularly rugulose, with abundant erect setae longer than maximum width of scape; hypostomal margin flat; median tooth a broad gibbosity; inner hypostomal teeth stout, closer to midline than to outer hypostomal teeth; with abundant erect setae projecting



from sides of head in full face view; promesonotal groove present; propodeal spines present; mesosoma shallowly foveolate overlain with reticulate rugulae; dorsal (outer) margin of hind tibia with abundant erect setae longer than maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view transverse, with strongly-developed lateral conules; first gastral tergite shallowly foveolate anteriorly, grading to smooth and shining posteriorly, with abundant flexuous erect setae; color brown.

### Biology

This species occurs in lowland to mid-elevation wet forest. Minor workers have been collected at baits. One major worker has been collected, at a bait along with minor workers.

### Etymology

The name is in reference to the elongate, flask-shaped postpetiole.

### Additional material examined

MEXICO: Chiapas, Lago Metzabok, 17°07'26"N, 91°38'11"W, 575m (LLAMA); Nahá, 16°57'49"N, 91°35'36"W, 985m (LLAMA).

### *Pheidole laselva*

*Pheidole laselva* Wilson 2003: 442, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Heredia, near Puerto Viejo, La Selva Biological Station (Cover/Moffett/Tobin) [MCZ] (examined).

*Pheidole ebenina* Wilson 2003: 412, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Guanacaste, Guanacaste Conservation Area, Pitilla research station, 500m, 14 Oct 1992, tuna bait (Olson) [MCZ] (examined). **New synonymy.**

### Geographic Range

Costa Rica, Colombia, Ecuador.

### Biology

This species occurs in mature wet forest habitats. In Costa Rica it is common below 500m elevation but there are records to 1220m. Major and minor workers are common at baits and in Winkler samples. Nest are in soft rotten wood and under loose bark of rotting logs.

### Comments

The types of *P. ebenina* are well within the range of variation of *P. laselva* and there is no substantial difference.

The collection at MCZ contains several series from Colombia and one from Ecuador that closely match the morphology of *P. laselva*. All of them are from montane areas, above 500m, instead of lowland rainforest like the Costa Rican population.

### *Pheidole leoncortesi* new species

Figure 13

**Holotype major worker.** Mexico, Chiapas: 21km SW Salto de Agua, 17.38542°N 92.42802°W, ±200m, 180m, 15 Jun 2008 (LLAMA#Ba-A-08-3-01-03) [UNAM, unique specimen identifier CASENT0609109].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, UCD, UNAM, ICN, USNM].



**FIGURE 13.** *Pheidole leoncortesi*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.

## Geographic Range

Mexico (Chiapas).

## Diagnosis

With the general habitus and morphometric profile of *P. tschinkeli*, with which it is sympatric. Minor and major worker: katapisternum and side of propodeum uniformly foveolate *versus* with conspicuous rugulae overlaying foveolate sculpture; propodeal spines short, tapering, with sharp tips, *versus* long, not tapering, tips blunt.

## Description of minor worker

*Measurements* (paratype): HL 0.72, HW 0.65, HLA 0.28, SL 0.78, EL 0.16, ML 0.94, PSL 0.07, PMG 0.03, SPL 0.03, PTW 0.13, PPW 0.20, CI 90, SI 120, PSLI 10, PMGI 3, SPLI 4, PPI 154.

*Measurements* (n=10): HL 0.67–0.78, HW 0.59–0.68, SL 0.73–0.86, CI 87–91, SI 120–127.

Mandible, clypeus, and entire face smooth and shiny, highly polished; margin of vertex rounded with median impression; occipital carina narrow, barely visible in full face view; scape with abundant erect setae longer than maximum width of scape; promesonotal groove present, strongly impressed; propodeal spines present, with sharp tips; katapisternum and side of propodeum foveolate, rest of mesosoma smooth and shining; mesosomal dorsum with about six pairs erect black setae; dorsal (outer) margin of hind tibia with appressed pubescence and 4–6 suberect setae that are longer than maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with moderately abundant, erect stiff black setae; color dark red brown.

## Description of major worker

*Measurements* (holotype): HL 1.13, HW 1.08, HLA 0.32, SL 0.79, EL 0.19, ML 1.07, PSL 0.10, PMG 0.05, SPL 0.05, PTW 0.21, PPW 0.32, IHT 0.43, OHT 0.49, CI 96, SI 73, PSLI 9, PMGI 4, SPLI 4, PPI 154, HTI 87.

*Measurements* (n=10): HL 1.09–1.21, HW 1.07–1.18, SL 0.76–0.84, CI 94–98, SI 67–74.

Mandible smooth and shiny; clypeus smooth and flat with distinct anterior notch; face mostly smooth and shiny, with a few carinulae on malar space; head lacking setae projecting from sides of head in face view; scape smooth and shining, terete at base, with appressed pubescence and abundant erect setae longer than maximum width of scape; hypostomal margin flat; median tooth absent or a small gibbosity; inner hypostomal teeth thin and sharp, located much closer to outer hypostomal teeth than to midline; promesonotal groove present; propodeal spines present; katapisternum and side of propodeum foveolate, rest of mesosoma smooth and shining; mesosomal dorsum with about six pairs erect black setae; dorsal (outer) margin of hind tibia with appressed pubescence and 4–8 suberect setae that are longer than maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with moderately abundant, erect stiff black setae; color dark red brown.

## Biology

This species occurs in wet forest habitat. It is locally abundant and recruits heavily to baits on the forest floor. Major and minor workers frequently occur together at baits. The nest is unknown.

## Etymology

The species is named for Dr. Jorge León Cortés, Director of the San Cristobal campus of the Colegio de la Frontera Sur, Chiapas, Mexico. Jorge was an extremely generous and effective host during LLAMA project sampling in Chiapas. He is an energetic field biologist actively promoting biological studies in Chiapas.

## Additional material examined

MEXICO: Chiapas, 13.7km NW Metzabok, 17°11'26"N, 91°44'15"W, 540m (LLAMA).

## *Pheidole mackayi*

Figure 14

*Pheidole mackayi* Wilson 2003: 448, figs (part, minor worker is misidentified *P. janzeni*). Holotype major worker: Mexico, Chiapas, 24km SW Cintalpa [Cintalapa], 710m, 2 Jun 1988, slashed and burned area, surface bait trap Vienna sausage (W. M. MacKay #107171) [MCZ] (examined).

### Geographic Range

Mexico (Chiapas).

### Description of minor worker (previously undescribed)

*Measurements* (n=1): HL 0.60, HW 0.51, SL 0.65, HLA 0.21, EL 0.13, ML 0.73, PSL 0.05, PMG 0.02, SPL 0.02, PTW 0.11, PPW 0.16, CI 85, SI 126, PSLI 9, PMGI 4, SPLI 4, PPI 146.

Mandible roughened, dull at base, grading to smooth and shiny near masticatory margin; clypeus strongly convex, largely smooth and shining with 2–4 longitudinal rugulae; face largely smooth and shiny, with faint foveolate sculpture between frontal carina and compound eye, extending posterior to compound eye on side of head, small irregular patches of faint foveolate sculpture elsewhere; margin of vertex flattened posteriorly; occipital carina narrow, barely visible in full face view; scape foveolate, with abundant decumbent setae and sparse suberect setae that are subequal in length to maximum width of scape; promesonotal groove present; propodeal spines present; pronotum foveolate with dorsal shiny patch; katapisternum and propodeum foveolate; about 12 short, curved, somewhat stiffened setae on mesosomal dorsum; dorsal (outer) margin of hind tibia with short decumbent setae and sparse suberect setae that are subequal in length to maximum width of tibia; dorsal surface of postpetiole faintly foveolate; first gastral tergum with fine short striations near postpetiolar insertion, smooth and shining elsewhere; gastral dorsum with moderately abundant, somewhat stiff setae; color red brown.

### Description of major worker

*Measurements* (holotype): HL 0.86, HW 0.84, SL 0.52, EL 0.12, IHT 0.28, OHT 0.35, CI 98, SI 62, HTI 79.

Mandible shiny, with coarse piligerous puncta, coarse striae at base; clypeus smooth and flat with distinct anterior notch; frontal carinae somewhat elevated and laminar; face rugose foveolate on sides of head between frontal carina and compound eye, gradually fading behind eye to smooth and shiny vertex lobes (extent of shiny area variable), medial area an irregular mixture of smooth and shiny patches, longitudinal rugulae near frontal carinae, and patches of faint foveolate sculpture; posterior margin of vertex with sparse stiff erect setae, side of head in full face view with short appressed setae only, no projecting erect setae; scape foveolate, terete at base, with appressed pubescence and sparse erect setae subequal in length to maximum width of scape; hypostomal margin gently curved; median tooth small to absent; inner hypostomal teeth minute denticles (may be drawn out into thin, needle-like spines) closer to outer hypostomal teeth than to midline; promesonotal groove present; propodeal spines present; mesosoma largely foveolate with variable extent of shiny patch dorsally; dorsal (outer) margin of hind tibia with appressed pubescence and sparse erect setae subequal in length to maximum width of tibia; 12–14 stiff erect setae on mesosomal dorsum; postpetiole in dorsal view globular, wider than long, faintly foveolate; first gastral tergum with small area of fine short striations near postpetiolar insertion, smooth and shining elsewhere; gastral dorsum with abundant, somewhat stiff setae; color red brown.

### Biology

This species occurs in disturbed habitats in seasonally dry climates, from 700–1400m elevation. The few collections, minor and major workers, have been from baits.



**FIGURE 14.** *Pheidole mackayi*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–H: MEXICO: Chiapas, Sierra Morena, 16°09'15"N, 93°35'23"W, 1150m (J. Longino#6242). Scale bar 0.5mm for A, E, 1mm for others.

## Comments

Additional collections of *P. mackayi* from near the type locality and sympatric collections of the new species *P. janzeni* revealed that the type collection of *P. mackayi* was a mixed series.

## Additional material examined

MEXICO: Chiapas, Sierra Morena, 16°09'15"N, 93°35'23"W, 1150m (J. Longino).

## *Pheidole mesomontana* new species

Figure 15

**Holotype major worker.** Costa Rica, Heredia: 16km SSE La Virgen, 10.26667°N 84.08333°W, ±2000m, 1100m, 19 Mar 2001 (ALAS#11/WF/03/36) [INBC, unique specimen identifier INB0003214187].

**Paratypes:** major and minor workers. Same locality as holotype but 18 Feb 2001 (R. Vargas#01-RVC-037), 17 Mar 2001 (R. Vargas#01-RVC-063), 16 Mar 2001 (M. Paniagua#11/RG/MPG/006), 20 Feb 2001 (ALAS#11/WF/01/13 and 11/WF/01/all), 19 Mar 2001 (ALAS#11/WF/03/24 and 11/WF/03/36) [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, MEL, UCD, UNAM, ICN, USNM].

## Geographic Range

Costa Rica.

## Diagnosis

Each caste separately with the morphometric profile of many species, but the combination of minor and major worker measurements and general habitus are similar to the allopatric *Pheidole hedlundorum* (a montane species from Venezuela), and the sympatric *P. umphreyi* and *P. erratilis*. Minor worker: not readily distinguishable from similar species; the propodeal spines are spiniform *versus* somewhat more triangular in *erratilis*. Major worker: face with faint foveolate sculpture covering entire vertex lobes *versus* smooth and shining (*hedlundorum*, *umphreyi*); head with convex sides but not diverging, *versus* relatively more cordate (*hedlundorum*, *umphreyi*); hypostomal margin curved and inner hypostomal teeth stout, *versus* hypostomal margin relatively flat and inner hypostomal teeth reduced to inconspicuous denticles (*hedlundorum*, *umphreyi*).

## Description of minor worker

*Measurements* (paratype): HL 0.66, HW 0.63, HLA 0.20, SL 0.67, EL 0.15, ML 0.83, PSL 0.06, PMG 0.01, SPL 0.03, PTW 0.13, PPW 0.19, CI 96, SI 106, PSLI 9, PMGI 1, SPLI 5, PPI 149.

*Measurements* (n=6): HL 0.60–0.66, HW 0.58–0.63, SL 0.64–0.67, CI 93–97, SI 106–114.

Mandible striate at base, grading to smooth and shiny on rest of dorsal surface; clypeus and face smooth and shiny; posterior margin of vertex flattened; occipital carina narrow, visible in full face view; scape rugulose, with abundant erect setae longer than maximum width of scape; promesonotal groove indistinct; propodeal spines present; pronotal humerus developed as an angular boss, with faint foveolate sculpture around boss, rest of pronotum smooth and shining; katapisternum and side of propodeum irregularly rugulose foveate; dorsal face of propodeum faintly foveolate; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with erect setae subequal in length to maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with abundant erect setae; color dark red brown.

## Description of major worker

*Measurements* (holotype): HL 1.20, HW 1.18, HLA 0.26, SL 0.68, EL 0.20, ML 1.01, PSL 0.11, PMG 0.00, SPL 0.05, PTW 0.19, PPW 0.30, IHT 0.25, OHT 0.39, CI 99, SI 57, PSLI 9, PMGI 0, SPLI 4, PPI 159, HTI 64.



**FIGURE 15.** *Pheidole mesomontana*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–D, Holotype major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.

*Measurements* (n=3): HL 1.13–1.20, HW 1.12–1.18, SL 0.63–0.68, CI 99–101, SI 56–59.

Mandible striate at base, grading to smooth and shiny on rest of dorsal surface; clypeus smooth and shallowly concave, with shallow anterior notch; face with median groove, widely-spaced longitudinal rugae between frontal carinae and compound eye, obliquely radiating rugae between frontal carinae, grading to faint foveolate sculpture on vertex lobes; head with abundant suberect setae projecting from sides of head in face view; scape foveolate rugulose, not shining, slightly curved and flattened at base (but width at base still less than maximum width of scape at apex), with abundant erect setae longer than maximum width of scape; hypostomal margin strongly concave medially; median tooth broad, blunt; inner hypostomal teeth stout, slightly closer to outer hypostomal teeth than to midline; promesonotal groove absent; propodeal spines present; pronotal humerus developed as blunt tubercle; anterodorsal face of pronotum with widely-spaced, transverse rugulae; lateral face of pronotum smooth and shining; katepisternum, anepisternum, and side of propodeum coarsely and irregularly rugose; mesonotal dorsum broad, flat, with smooth spaces and irregular rugulae; dorsal face of propodeum with faint irregular rugulae; dorsal (outer) margin of hind tibia with abundant suberect setae subequal in length to maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view weakly trapezoidal; first gastral tergite smooth and shining, with abundant erect setae; color dark red brown.

### Biology

This species occurs in mature mid-elevation wet forest. It is known from only one locality but it is relatively abundant at that locality. The Project ALAS survey at the 1070m site on the Barva transect yielded numerous collections in Malaise traps, pan traps on the ground, and Winkler samples of sifted leaf litter from the forest floor.

### Etymology

The name is in reference to the narrow mid-elevation range of the species.

### *Pheidole mooreorum*

*Pheidole mooreorum* Wilson, 2003: 209, figs. Holotype major worker and associated paratype minor worker: Mexico, Veracruz, Los Tuxtlas, 10km NNW Sontecomapan, 18°35'N 95°05'W, 200m, 20 Mar 1985, ground foragers, rainforest (P. S. Ward 7339) [MCZ] (examined).

*Pheidole fariasana* Wilson, 2003: 155, figs. Holotype major worker and associated paratype minor worker: Mexico, Tamaulipas, 1mi E Gomez Farias, 1400', 23 Dec 1972, deciduous tropical forest, nesting in ground under stone (R. J. Hamton, A. B. Hamton, B. S. Ikeda) [MCZ] (examined). **New synonymy.**

### Geographic Range

Mexico (Tamaulipas) to Costa Rica (northern Pacific lowlands and northern cordilleras).

### Biology

This species occurs in a wide variety of habitats: dry forest, rainforest, and cloud forest, from sea level to 1800m elevation, in disturbed synanthropic habitats or less disturbed forest with intact canopy. It can be locally common. Collections are most often from baits on forest floor, or scattered workers in Winkler samples. Major workers are often recruited to baits along with minor workers. The types of *P. fariasana* were from a nest found beneath a stone.

### Comments

Over the range of the species there is strong intra- and inter-populational variation. Minor workers: the pronotum may be entirely and strongly foveolate (rarely), it may show a patchwork of foveolate sculpture and smooth shiny areas, or it may be completely smooth and shining. Correlated with this is face sculpture, which



is usually completely smooth and shining, but in forms with more sculpture on the pronotum the face may have very faint patches of foveolate sculpture. Major worker: in general the anterior face has longitudinal rugulae with smooth shiny interspaces, and the posterior face is completely smooth and shining. The transition may occur abruptly or gradually, and from just anterior to the level of the compound eyes to somewhat posterior to them. The medial area between the frontal carinae may be completely smooth and shining, or with variable numbers of longitudinal rugulae parallel to and beginning at the frontal carinae and fading medially. The strength and extent of face rugulae correlates with strength of pronotal sculpture on minor workers. The setae projecting from the side of the head in face view vary from long and suberect to short and appressed.

The minor workers of the type series of *P. fariasana* from Tamaulipas have the intermediate sculptural condition, in which the pronotum is mostly smooth and shining, with a narrow band of foveolate sculpture at the anterior margin and wrapping around onto the ventrolateral margin. The major workers have the face rugulae extending posterior to the compound eyes, and there are abundant suberect setae projecting from the side of the head. In the Sierra Madre de Chiapas, most collections have the intermediate sculptural condition, but the full range of variation occurs. At lower elevations in northern Chiapas, in wet forest areas from 500–1000m, the most common condition is for the pronotum of the minor worker to be almost entirely smooth and shiny, and the side of the head in the major worker with shorter, more decumbent setae. The type series of *P. mooreorum*, from Veracruz, matches this lowland form, with the setae on the side of the head even more reduced than on the lowland Chiapas material.

One minor worker from a 500m site in northern Chiapas (Metzabok) and one minor worker from a lowland site in the Lacandon rainforest of northern Chiapas (Playón de la Gloria) have a faint purple sheen, like *P. purpurea*. Unlike *P. purpurea*, the pronotum is smooth and shining. These collections do not have associated majors, and given the similarity of minor workers of *P. mooreorum* and *P. purpurea*, these may be variants of *P. purpurea* instead of *P. mooreorum*.

Sparse minor worker collections from montane sites in Guatemala, and multiple collections with major workers from lowland dry forest habitat in northwestern Costa Rica are, on average, like the type series of *P. fariasana*. Occasionally the sculpture is more extensive. In some lighting conditions the Costa Rican material may have a very faint purple sheen.

In the Cordillera de Tilarán in Costa Rica, in moist forest around 1400m elevation, a relatively uniform population occurs in which the minor workers have a strongly sculptured pronotum, and the minor workers are somewhat bicolored, with mesosoma light brown and head and gaster darker brown.

In Chiapas, Mexico, *P. mooreorum* is broadly sympatric with *P. purpurea*, with the former being more abundant in middle to high elevations and the latter relatively more abundant in the lowlands. The minor workers are indistinguishable in the Sierra Madre de Chiapas, where both have an intermediate sculptural condition on the minor worker pronotum and neither have the purple sheen. In the Chiapas lowlands they are more differentiated, with *P. mooreorum* having a smooth pronotum and no purple sheen, and *P. purpurea* having a sculptured pronotum and often a purple sheen.

Given the high degree of morphological variability, it is likely that *P. mooreorum* will resolve into multiple cryptic species.

### ***Pheidole nebulosa***

*Pheidole nebulosa* Wilson, 2003: 470, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Heredia, La Selva Biological Station, near Puerto Viejo (Cover, Moffett, Tobin) [MCZ] (examined).

*Pheidole scabriventris* Wilson, 2003: 503, figs. Holotype major worker and associated paratype minor worker: Mexico, Veracruz, park cañon, 2mi W Fortin, Hwy 150, 6–9 Aug 1969 (S. & J. Peck) [MCZ] (examined). **New synonymy.**

### **Geographic Range**

Mexico to Costa Rica.

## Biology

This species inhabits mature wet forest. It appears to be both arboreal and terrestrial, occurring commonly in forest floor leaf litter and in the canopy. Nests are in irregular cavities in dead wood. Wilson (2005) observed that *P. nebulosa* and two other species of small *Pheidole* (*flavens* and *bilimeki*) frequently prey on oribatid mites in the leaf litter.

## Comments

*Pheidole nebulosa* has a highly distinctive feature in the major workers: there is a single large rounded medial tooth on the hypostomal margin and no inner hypostomal teeth. All other Central American *Pheidole* in the same size range and with similar sculptural features have inner hypostomal teeth. The only difference between the types of *P. scabriventris* and *P. nebulosa* is color. The former is red brown instead of yellow.

## *Pheidole nitidicollis*

*Pheidole dimidiata* var. *nitidicollis* Emery, 1896: 79. Lectotype major worker (here designated, as labeled by Wilson 2003) and associated paralectotype minor worker: Costa Rica, Jiménez [a site near present day La Selva Biological Station] (Alfaro) [MCSN] (not examined). Subspecies of *dimidiata*: Emery, 1922: 107. Raised to species: Wilson, 2003: 474.

*Pheidole sagana* Wheeler, W.M. 1934: 169. Lectotype major worker (here designated, as labeled by Wilson 2003) and associated paralectotype minor worker: Mexico, Veracruz, Mirador (Skwarra) [MCZ] (examined). See also: Wilson, 2003: 501. **New synonymy.**

## Geographic Range

Mexico to Costa Rica.

## Biology

This species occurs in mature wet forest. It is a relatively common arboreal ant, nesting in dead branches and under epiphytes. Colonies often appear large, with workers scattered over a wide area.

## Comments

The conclusion of synonymy of *P. sagana* under *P. nitidicollis* is based on the illustrations of type material of *P. nitidicollis* in Wilson (2003), the identification as *P. nitidicollis* of abundant new material from near the type locality, and the direct comparison of that material with the types of *P. sagana*.

## *Pheidole pararugiceps* new species

Figure 16

**Holotype major worker.** Costa Rica, Heredia: 16km SSE La Virgen, 10.26667°N 84.08333°W, ±2000m, 1100m, 20 Feb 2001 (ALAS#11/WF/01/48) [INBC, unique specimen identifier INB0003213441].

**Paratypes:** major and minor workers. Same data as holotype; same locality as holotype but 10 Mar 2001 (Alas#11/TN/08/013), 20 Feb 2001 (ALAS#11/WF/01/41, 11/WF/01/all) [BMNH, CAS, FMNH, INBC, JTLC, LACM, MCZ, UCD, USNM].

## Geographic Range

Costa Rica.



**FIGURE 16.** *Pheidole pararugiceps*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–D, Holotype major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.

## Diagnosis

This is one of the few species in which the minor worker completely lacks propodeal spines. It is like an orange and slightly larger version of *Pheidole rugiceps*, with which it is sympatric. Minor worker: color orange, size larger (HW > 0.50), and scapes relatively long (SI > 160), *versus* color usually dark brown to black (rarely orange), size smaller (HW < 0.45), and scapes relatively shorter (SI < 150) (*rugiceps*). Major worker: color as in minor worker; vertex lobes smooth and shining, size larger (HW > 1.00), *versus* longitudinal rugulae covering entire face, to posterior margin of vertex, and size smaller (HW < 0.95) (*rugiceps*).

## Description of minor worker

*Measurements* (paratype): HL 0.61, HW 0.51, HLA 0.21, SL 0.82, EL 0.14, ML 0.78, PSL 0.00, PMG 0.02, SPL 0.04, PTW 0.09, PPW 0.11, CI 82, SI 163, PSLI 0, PMGI 3, SPLI 7, PPI 123.

*Measurements* (n=5): HL 0.61–0.67, HW 0.50–0.56, SL 0.80–0.87, CI 79–83, SI 156–163.

Mandible and clypeus smooth and shiny; face foveolate with irregular shiny patches medially; margin of vertex rounded; occipital carina narrow, visible in full face view; scape with abundant subdecumbent pubescence and scattered suberect setae that are slightly longer than maximum width of scape; promesonotal groove present; propodeal spines absent; pronotum smooth and shiny with band of faint foveolae anteriorly; katapisternum and propodeum foveolate; sparse erect setae on mesosomal dorsum; dorsal (outer) margin of hind tibia with subdecumbent pilosity and 3 pairs of erect setae subequal in length to maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with abundant erect setae; color orange.

## Description of major worker

*Measurements* (holotype): HL 1.08, HW 1.02, HLA 0.27, SL 0.80, EL 0.18, ML 0.88, PSL 0.04, PMG 0.03, SPL 0.06, PTW 0.13, PPW 0.20, IHT 0.25, OHT 0.40, CI 95, SI 78, PSLI 4, PMGI 3, SPLI 5, PPI 153, HTI 61.

*Measurements* (n=2): HL 1.08–1.18, HW 1.02–1.12, SL 0.80–0.84, CI 95–95, SI 75–78.

Mandibles shiny, with coarse piligerous puncta, blunt longitudinal striae basally; clypeus smooth and flat with straight anterior margin; face with deep median groove, longitudinal rugae anteriorly, concentric around antennal insertion, radiating obliquely from between frontal carinae, fading to smooth and shining vertex lobes; head with abundant suberect setae projecting from sides of head in face view; scape smooth and shining, terete at base, with abundant erect setae longer than maximum width of scape; hypostomal margin flat; median tooth present, blunt; inner hypostomal teeth blunt, stout, slightly closer to midline than to outer hypostomal teeth; promesonotal groove present; propodeal spines present, short; pronotum smooth and shining; katapisternum and propodeum foveolate; dorsal (outer) margin of hind tibia with pilosity similar to minor worker; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view trapezoidal; first gastral tergite smooth and shining, with abundant erect setae; color orange.

## Biology

*Pheidole pararugiceps* is known from four different collections, all from the same locality. They were collected at the 1070m site on the Barva transect in Braulio Carrillo National Park. This is a very wet forested site. The four collections were from the ALAS project. Two were Winkler samples of sifted leaf litter from the forest floor; one was in a pan trap on the ground, and one was a Berlese sample of rotting wood and fungi.

## Etymology

The name is in reference to the similarity to *P. rugiceps* Wilson.

## *Pheidole perpustakaan*

*Pheidole flavens* subsp. *perpustakaan* Emery, 1894:157. Syntype major, minor worker, gyne: Brazil, Pará (Schulz). Emery, 1896g: 80: raised to species.

*Pheidole flavens* var. *breviscapa* Forel, 1899: 77. Holotype major worker: Guatemala, Retalhuleu (Stoll) [MHNG] (examined). Wilson, 2003: 383: raised to species. **New synonymy.**

*Pheidole decem* Forel, 1901a: 366. Syntype major worker: Trinidad. Wilson, 2003: 553: junior synonym of *P. perpusilla*.

*Pheidole* (*Hendecapheidole*) *emersoni* Wheeler, W.M. 1922: 4, fig. 2. Syntype minor worker, gyne, male: Guyana, Kartabo (Emerson). Wilson, 2003: 553: junior synonym of *P. perpusilla*.

### Geographic Range

Amazonian Brazil to southern Mexico.

### Biology

This species occurs in wet climate areas, from sea level to 1200m elevation. In mature forest areas it is a common species under epiphytes in the canopy, although its minute size makes it easy to overlook. It also occurs on trees in synanthropic habitats such as coffee farms and city parks.

### Comments

The holotype of *P. breviscapa* has 10-segmented antennae and is a close match to Costa Rican material of *P. perpusilla*.

### *Pheidole phanigaster* new species

Figure 17

**Holotype major worker.** Mexico, Chiapas: 21km SW Salto de Agua, 17.38542°N 92.42802°W, ±200m, 180m, 15 Jun 2008 (LLAMA#Ba-A-08-3-02-10) [UNAM, unique specimen identifier CASENT0609087].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, UCD, UNAM, USNM].

### Geographic Range

Mexico (Chiapas).

### Diagnosis

With the morphometric profile of *P. anastasioi* but the shape and general habitus of *P. nebulosa*. Minor worker: scape relatively long (SI 119–122) *versus* short (SI 104–106) (*nebulosa*); gastral dorsum shiny *versus* matte (*anastasioi*); postpetiole in dorsal view lenticular *versus* flask-shaped, widest posterior to midlength (*anastasioi*). Major worker: inner hypostomal teeth present and separated from median tooth *versus* medial hypostomal margin with large blunt medial tooth only (*nebulosa*); postpetiole in dorsal view lenticular, widest at or anterior to midlength, *versus* postpetiole flask-shaped, widest posterior to midlength (*anastasioi*); color red brown *versus* usually yellow orange (*anastasioi*).

### Description of minor worker

*Measurements* (paratype): HL 0.49, HW 0.43, HLA 0.17, SL 0.52, EL 0.10, ML 0.55, PSL 0.05, PMG 0.00, SPL 0.03, PTW 0.07, PPW 0.11, CI 88, SI 120, PSLI 10, PMGI 0, SPLI 5, PPI 147.

*Measurements* (n=7): HL 0.46–0.50, HW 0.39–0.44, SL 0.46–0.53, CI 84–89, SI 119–122.

Mandible smooth and shiny; clypeus foveolate; face uniformly foveolate; margin of vertex rounded with median impression; occipital carina narrow, not or barely visible in full face view; scape with appressed pubescence and sparse, fine erect setae, these longer than maximum width of scape; promesonotal groove absent; propodeal spines present; entire mesosoma foveolate; mesosomal dorsum with about six pairs erect setae; dorsal (outer) margin of hind tibia with short decumbent pilosity, no long erect setae; first gastral tergum smooth and shining; gastral dorsum with moderately abundant erect setae; color orange.



**FIGURE 17.** *Pheidole phanigaster*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, F, G, 1mm for others.

## Description of major worker

*Measurements* (holotype): HL 1.08, HW 1.01, HLA 0.28, SL 0.61, EL 0.15, ML 0.86, PSL 0.11, PMG 0.00, SPL 0.05, PTW 0.12, PPW 0.26, IHT 0.24, OHT 0.39, CI 94, SI 60, PSLI 10, PMGI 0, SPLI 4, PPI 207, HTI 60.

*Measurements* (n=7): HL 0.95–1.08, HW 0.90–1.03, SL 0.58–0.62, CI 94–97, SI 60–64.

Mandible smooth and shiny; clypeus shiny, slightly concave, with median carina and parallel longitudinal carinulae laterally, with prominent anterior notch; face foveolate throughout, overlain with parallel rugulae on malar spaces and between frontal carinae, becoming more reticulate and fainter posteriorly; head with abundant suberect setae projecting from sides of head in face view; scape smooth and shining, terete at base, with sparse erect setae longer than maximum width of scape; hypostomal margin flat, median tooth present, usually prominent and larger than inner hypostomal teeth; inner hypostomal teeth present, stout, about one half distance from midline to outer hypostomal teeth; promesonotal groove not distinct; propodeal spines present; mesosoma largely foveolate, with shiny area at anterodorsal margin of pronotum; dorsal (outer) margin of hind tibia with appressed pubescence, no longer erect setae; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view lenticular, widest at midlength, conules moderately developed; first gastral tergite matte, with abundant long stiff erect setae; head and mesosoma generally red brown with greater infuscation on mesosomal dorsum, first gastral tergum orange anteriorly, posterior portion and rest of gastral dorsum darker red brown.

## Biology

This species is known from numerous baiting samples in wet forest habitat, in one locality in the northern Chiapas lowlands.

## Etymology

The name is in reference to the smooth and shiny gaster of the minor worker, in contrast to the matte gaster of the similar *P. anastasioi*.

## *Pheidole picobarva* new species

Figure 18

**Holotype major worker.** Costa Rica, Heredia: 6km ENE Vara Blanca, 10.18333°N 84.11667°W, ±2000m, 2000m, 6 Nov 2002 (J. Longino#4838) [INBC, unique specimen identifier CASENT0610059].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, EAPZ, ECOSCE, FMNH, INBC, LACM, MCZ, MHNG, MIZA, MZSP, MEL, UCD, ICN, USNM].

## Geographic Range

Costa Rica.

## Diagnosis

With the morphometric profile of *P. rutilana* Wilson, from Brazil, and *P. ulothrix* Wilson, which occurs at lower elevation on the same mountain slope as the type locality. **Minor worker:** face with extensive carinulate etching on anterior face, extending posterior to compound eyes, *versus* face almost completely smooth and shining, with a few longitudinal carinulae between frontal carina and compound eye, but none extending posterior to eye (*rutilana*); clypeus with a somewhat produced posterior portion between frontal carinae, dropping abruptly to anterior portion, *versus* clypeus shallowly and evenly convex (*rutilana*, *ulothrix*); dorsal surface of hind tibia with subdecumbent setae subequal in length to maximum width of tibia *versus* with suberect setae longer than maximum width of tibia (*ulothrix*); color dark red brown *versus* orange (*ulothrix*). **Major worker:** undersurface of head extensively sculptured with carinulate etching and faint foveolae *versus* undersurface of head largely smooth and shining, with a few longitudinal carinulae laterally (*rutilana*,

*ulothrix*); inner hypostomal teeth stout and located closer to midline than to outer hypostomal teeth *versus* inner hypostomal teeth small and located about midway between outer hypostomal teeth and midline (*rutilana*); clypeus smooth and shining *versus* with median longitudinal carina (*rutilana*); postpetiole in dorsal view trapezoidal *versus* globular (*rutilana*, *ulothrix*); tibial pilosity as in minor worker; color dark red brown *versus* orange (*ulothrix*).

### Description of minor worker

*Measurements* (paratype): HL 0.58, HW 0.58, HLA 0.16, SL 0.57, EL 0.15, ML 0.74, PSL 0.05, PMG 0.00, SPL 0.03, PTW 0.11, PPW 0.16, CI 100, SI 98, PSLI 9, PMGI 0, SPLI 4, PPI 146.

*Measurements* (n=6): HL 0.58–0.65, HW 0.57–0.60, SL 0.57–0.60, CI 92–100, SI 98–100.

Mandible smooth and shining; clypeus smooth and shining, somewhat produced posteriorly between frontal carinae, dropping abruptly to anterior portion; face with fine longitudinal carinulae between frontal carina and compound eye, extending just posterior to eye, concentric around antennal insertion, and fan-like medial to frontal carina, median face between frontal carinae and posterior portion of face smooth and shining; margin of vertex rounded with small median impression; occipital carina narrow, not visible in full face view; scape with abundant suberect setae, the longest subequal in length to maximum width of scape; promesonotal groove absent; propodeal spines present; pronotum smooth and shining; anepisternum foveolate; katapisternum foveolate dorsally and posteriorly, with large medial shiny patch; dorsal face dorsal portion of lateral face of propodeum foveolate, metapleural bulla smooth and shining with three longitudinal rugae; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with subdecumbent setae subequal in length to maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with abundant erect setae; color dark red brown.

### Description of major worker

*Measurements* (holotype): HL 1.20, HW 1.16, HLA 0.24, SL 0.62, EL 0.16, ML 0.94, PSL 0.07, PMG 0.00, SPL 0.05, PTW 0.19, PPW 0.27, IHT 0.25, OHT 0.44, CI 97, SI 54, PSLI 6, PMGI 0, SPLI 4, PPI 144, HTI 56.

*Measurements* (n=3): HL 1.15–1.20, HW 1.12–1.18, SL 0.62–0.66, CI 97–102, SI 54–57.

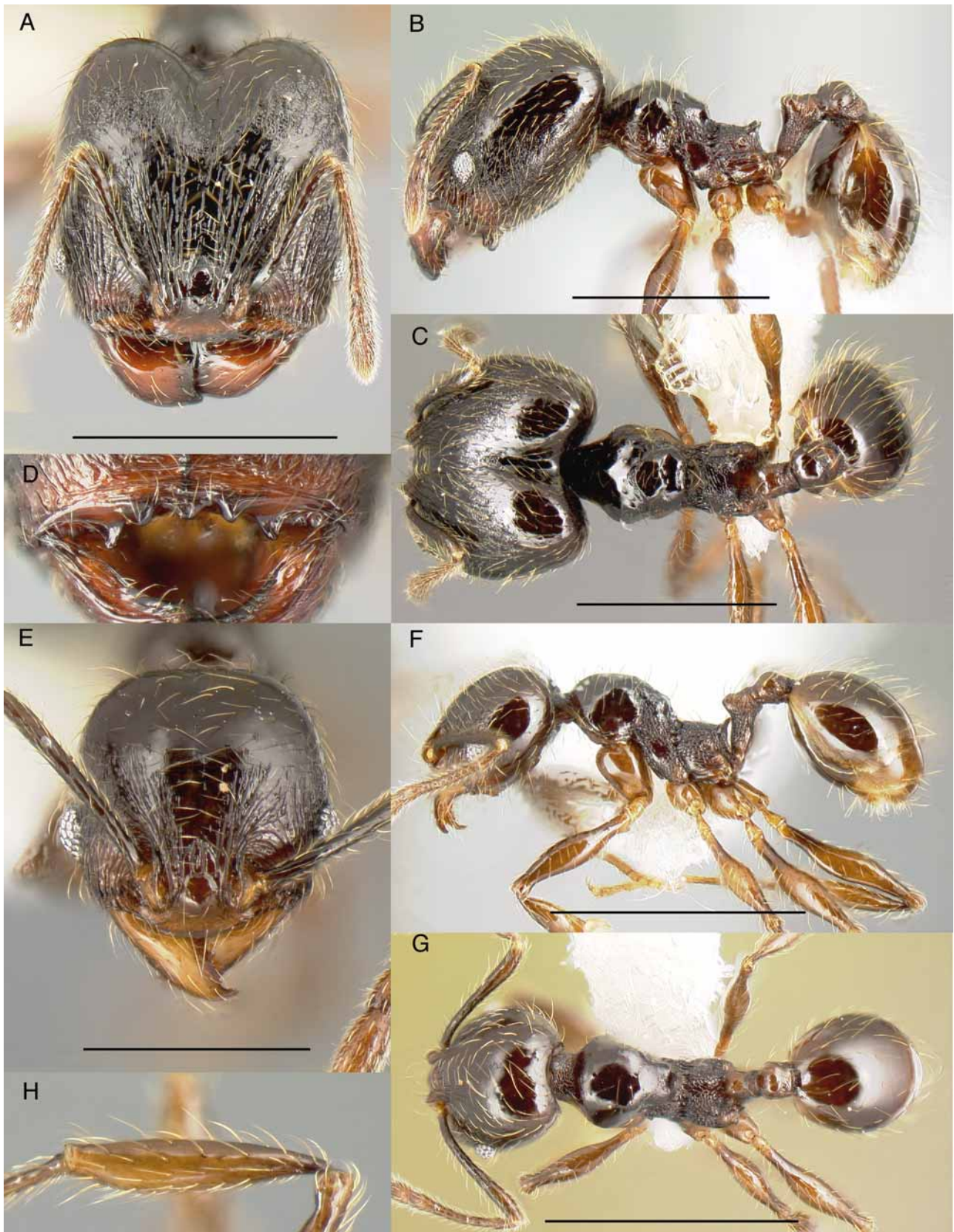
Mandibles smooth and shiny; clypeus smooth and flat with straight anterior border; side of head between frontal carina and compound eye with widely-spaced longitudinal rugae, grading to reticulate rugae underlain with foveolate sculpture on scrobal area, grading to smooth and shining posteriorly, medial area with radiating fan of longitudinal rugae between frontal carinae grading to smooth and shining with irregular small patches of foveolate sculpture; head with abundant short subdecumbent setae projecting from sides of head in face view; scape smooth and shining, terete at base, with abundant suberect setae, the longest of which longer than maximum width of scape; hypostomal margin straight; median tooth prominent, triangular; inner hypostomal teeth pointed, stout, closer to midline than to outer hypostomal teeth; undersurface of head extensively sculptured with carinulate etching and faint foveolae; promesonotal groove absent; propodeal spines present; promesonotum and katapisternum smooth and shining; ventral portion of side of propodeum smooth and shining with three coarse longitudinal rugae; dorsal portion of propodeum foveolate; dorsal (outer) margin of hind tibia with subdecumbent setae subequal in length to maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view trapezoidal; first gastral tergite smooth and shining, with abundant flexuous erect setae; color dark red brown.

### Biology

This species occurs in mature cloud forest. It appears to be a narrow elevational specialist, occurring only above 1900m on Volcan Barva. Minor workers have been collected in Winkler samples, Berlese samples, and sweepnet samples from Project ALAS. A complete nest series was obtained from a nest in epiphytic soil on a rotten log in an old treefall gap. The nest was in the side of the log where there was a vertical wall of humus. On excavation, small chambers were found at about 1cm depth, and the nest center was about 10cm deep. There were several hundred workers, numerous soldiers (in the deepest part of the nest), about a dozen adult



males, brood, and one dealate queen. The outer chambers contained small plant seeds, thinly spread on the walls and floors.



**FIGURE 18.** *Pheidole picobarva*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–D, Holotype major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.

## Etymology

The name is in reference to the restricted geographic range of this species on the peak of Volcan Barva in Costa Rica.

## *Pheidole potosiana*

*Pheidole potosiana* Wilson, 2003: 339, figs. Holotype major worker and associated paratype minor worker: Mexico, San Luis Potosí, 2mi NE Xilitla, 1400', 24 Dec 1972, deciduous tropical forest (R. J. Hamton, A. B. Hamton, B. S. Ikeda) [MCZ] (examined).

## Geographic Range

Southern Mexico to Costa Rica.

## Biology

This species occurs in wet to dry forest habitats. It is known almost exclusively from baits on the forest floor, although occasional workers occur in Winkler and Berlese samples.

## Comments

See under *P. acamata*.

## *Pheidole psilogaster*

*Pheidole psilogaster* Wilson, 2003: 341, figs. Holotype major worker and associated paratype minor worker: Mexico, Veracruz, Los Tuxtlas, 10km NNW Sontecomapan, 18°35'N 95°05'W, 500m, 21 Mar 1985, sifted litter, rainforest (P. S. Ward 7369-32). [MCZ] (examined).

## Geographic Range

Southern Mexico to Costa Rica.

## Biology

This species occurs in wet forest habitats from sea level to 1400m elevation. It is known mainly from baits on the forest floor, and occasionally workers occur in Winkler and Berlese samples. Major workers often recruit to baits along with minor workers. D. J. Cox collected a nest in standing dead wood.

## Comments

See under *P. acamata*.

## *Pheidole pubiventris*

*Pheidole pubiventris* Mayr, 1887: 595. Syntype major worker, minor worker, queen: Brazil, Santa Catarina (Hetschko) [NMW, MCZ] (examined).

*Pheidole pubiventris* subsp. *variegata* Emery, 1896: 72. Lectotype major worker (here designated, as labeled by Wilson 2003) and associated paralectotype minor worker, queen: Costa Rica, San José (Alfaro) [MHNG] (not examined). Wilson, 2003: 245: raised to species. **New synonymy.**

*Pheidole indistincta* Forel, 1899: 75. Lectotype major worker (here designated, as labeled by Wilson 2003): Costa Rica (Tonduz) [MHNG] (examined). **New synonymy.**

*Pheidole pubiventris* r. *cearensis* Forel, 1901a: 353. Syntype major, minor worker: Brazil, Ceará, Biturité (Schmitt) (not examined). Wilson, 2003: 218: junior synonym of *P. pubiventris*.

*Pheidole pubiventris* r. *nevadensis* Forel, 1901a: 353. Syntype major, minor worker, queen: Colombia, Magdalena, San

Antonio, >1000m elevation (Forel) (not examined). Wilson, 2003: 218: junior synonym of *P. pubiventris*.  
*Pheidole pubiventris* r. *timmi* Forel, 1901b: 62. Syntype major, minor worker: U.S.A., Louisiana, New Orleans, "probably of Mexican origin" (Timm) (not examined). Wilson, 2003: 218: junior synonym of *P. pubiventris*.

### Geographic Range

Southern Brazil to Mexico.

### Biology

This species occurs in open areas and synanthropic habitats. It has been collected at baits during the day or night, and as nocturnal foragers.

### Comments

This species appears to have a broad range, as often occurs in species favoring synanthropic habitats, but it is also infrequently collected and, among the few collections, shows a high degree of variability.

Collections by W. M. Wheeler at Cartago, Costa Rica, have the major worker scapes flattened at the base, the scapes are relatively short (SI 73), and the first gastral tergum has a cluster of about ten long erect setae anteriorly, underlain by fully appressed sparse pubescence, individual setae of which are about as long as distance among them. Specimens collected by Trager at CATIE, a site near Turrialba and only 30km from Cartago, have majors with thinner scape bases, longer scapes (SI 81), and the first gastral tergum with about five long erect setae and the underlying appressed pubescence much sparser, the individual setae of which are much further apart than their length. A collection from a dry forest site in lowland Guanacaste Conservation Area, Costa Rica, is very similar to the Cartago specimens, with major worker scapes flattened, SI 67, and similar underlying pubescence. Collections from southern Mexico (Sierra Madre de Chiapas) have major worker with flattened scapes, but the scapes are relatively long (SI 82) and the pubescence on the gaster is subdecumbent rather than fully appressed. The types of *P. pubiventris*, from southern Brazil, have the major worker scape somewhat flattened (more so than illustration in Wilson 2003:218), intermediate between the Cartago and CATIE collections from Costa Rica. Based on Wilson's measurements, scapes are relatively short, SI 75. No observations were made on the pilosity of the gaster. The types of Emery's *P. variegata*, from San José, Costa Rica, were not examined, but Wilson's illustration (2003:245) and measurements suggest a form with narrow scape bases and scapes relatively long (SI 84), perhaps similar to the CATIE collection. Finally, the lectotype major worker of Forel's *P. indistincta*, from "Costa Rica," is identical to Wheeler's Cartago collections. This was an early collection by Tonduz, and was probably from the same population in Costa Rica's central valley.

### *Pheidole purpurea* new species

Figure 19

**Holotype major worker.** Mexico, Chiapas: 21km SW Salto de Agua, 17.38542°N 92.42802°W, ±200m, 180m, 15 Jun 2008 (LLAMA#Ba-A-08-3-01-10) [UNAM, unique specimen identifier CASENT0609143].

**Paratypes:** major and minor workers. Same data as holotype; same data but LLAMA#Ba-A-08-3-03-18 and Ba-A-08-3-04-18 [BMNH, CAS, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, UCD, UNAM, USNM].

### Geographic Range

Mexico (Chiapas).

### Diagnosis

With the morphometric profile of *P. dentata*, *P. mooreorum*, and *P. hyatti*. Minor worker: color dark red brown to black and often with a metallic purple sheen *versus* color usually lighter orange brown (*dentata*,

*hyatti*) and never with a purple sheen (*dentata*, *hyatti*, *mooreorum*); posterior margin of vertex evenly rounded in face view *versus* somewhat flattened medially (*dentata*); pronotum usually foveolate with small shiny patches dorsally *versus* pronotum usually with foveolate sculpture reduced or absent (*mooreorum*). Major worker: irregular patches of faint foveolate sculpture and/or variable extent of reticulate rugulae on much of posterior face *versus* posterior half of face smooth and shining (*dentata*, *mooreorum*); base of scape narrower than broader distal portion *versus* basal bend of scape strongly flattened, as wide as distal scape (*hyatti*).

#### **Description of minor worker.**

*Measurements* (paratype): HL 0.66, HW 0.55, HLA 0.24, SL 0.85, EL 0.15, ML 0.86, PSL 0.04, PMG 0.03, SPL 0.03, PTW 0.11, PPW 0.16, CI 83, SI 156, PSLI 6, PMGI 4, SPLI 4, PPI 146.

*Measurements* (n=13): HL 0.63–0.73, HW 0.53–0.63, SL 0.81–0.91, CI 82–88, SI 134–157.

Face smooth and shiny, occasionally with faint patches of foveolate sculpture; margin of vertex rounded; occipital carina narrow, usually visible in full face view; scape with abundant erect setae longer than maximum width of scape; promesonotal groove present; propodeal spines present, short, upturned; pronotum varying from entirely foveolate to mostly smooth and shining, always with at least faint foveolation laterally; katepisternum and propodeum foveolate; abundant flexuous suberect setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with abundant suberect setae, longest subequal in length to maximum width of tibia; first gastral tergum smooth and shining, occasionally with small area of faint foveolate sculpture near postpetiolar insertion; gastral dorsum with abundant, flexuous setae; color dark red brown to black, with a metallic purple sheen that varies from very strong to completely absent.

#### **Description of major worker.**

*Measurements* (holotype): HL 1.18, HW 1.12, HLA 0.37, SL 0.89, EL 0.20, ML 1.10, PSL 0.07, PMG 0.03, SPL 0.05, PTW 0.19, PPW 0.28, IHT 0.40, OHT 0.50, CI 96, SI 79, PSLI 6, PMGI 3, SPLI 4, PPI 148, HTI 80.

*Measurements* (n=11): HL 1.09–1.25, HW 1.02–1.17, SL 0.85–0.98, CI 92–96, SI 75–89.

Mandibles smooth and shiny with abundant subdecumbent flexuous setae; clypeus smooth and flat with shallow anterior notch; face sculpture shallow but never smooth and shiny, composed of variable combination and distribution of faint foveolate sculpture and reticulate to longitudinal rugae, occasionally with posteromedian portion smooth and shining, but then with conspicuous piligerous puncta; head with abundant suberect setae projecting from sides of head in face view; scape faintly microfoveolate, subterete at base, with abundant erect setae as long as maximum width of scape; hypostomal margin straight; median tooth a small rounded nub or absent; inner hypostomal teeth thin, sharp, widely-spaced and close to outer hypostomal teeth; promesonotal groove impressed, conspicuous; propodeal spines present, short, upturned; pronotum and katepisternum moderately to faintly foveolate, overlain with shallow reticulate rugae; propodeum foveolate; abundant flexuous suberect setae on mesosomal dorsum; dorsal (outer) margin of hind tibia with abundant suberect setae, longest subequal in length to maximum width of tibia; dorsum of postpetiole foveolate; first gastral tergite largely smooth and shining, with small area of faint foveolate sculpture near postpetiolar insertion, gastral dorsum with abundant flexuous suberect setae; color as in minor worker.

#### **Biology**

*Pheidole purpurea* occurs in mesophyl forest throughout the state of Chiapas, Mexico, from sea level to nearly 1700m. It can be a common epigaeic forager, recruiting rapidly to baits on the ground and often recruiting major workers to baits. A nest was observed beneath a stone.

#### **Etymology**

The name is in reference to the violaceous reflections of the cuticle.



**FIGURE 19.** *Pheidole purpurea*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.

## Comments

*Pheidole purpurea* shows abundant geographic variation in traits, and some intra-populational variation. The metallic purple sheen is very strong in some populations (lowland areas of Lacandon rainforest, mid-elevation Pacific slope of southern Sierra Madre de Chiapas), faint in others (Laguna Metzabok and Nahá, 500–1000m in the Lacandon area), and absent in others (mid-elevation sites in central and northern portions of Sierra Madre de Chiapas). Foveolate sculpture on the lateral pronotum is usually well developed. A population in the central portion of the Sierra Madre de Chiapas (near Custepec) has the faintest pronotal sculpture observed among all the material examined (that and the lack of purple sheen make minor workers indistinguishable from *P. mooreorum* at the same site). Two minor workers from the northern end of the Sierra Madre de Chiapas (Sierra Morena), tentatively identified as *P. purpurea*, have the opposite extreme, with the heaviest pronotal sculpture observed.

## Additional material examined

MEXICO: Chiapas, Sierra Morena, 16°09'15"N, 93°35'23"W, 1150m (J. Longino); Custepec, 15°42'46"N, 92°56'25"W, 1660m (LLAMA); 13.7km NW Metzabok, 17°11'26"N, 91°44'15"W, 540m (R. S. Anderson); 2km S Playón de la Gloria, 16°08'19"N, 90°54'05"W, 170m (LLAMA); 12km NW Flor de Cafe, 16°08'25"N, 91°16'17"W, 520m (R. S. Anderson); 8km SE Salto de Agua, 17°30'57"N, 92°18'10"W, 100m (LLAMA); Lago Metzabok, 17°07'32"N, 91°37'51"W, 570m (LLAMA); 8km SE Salto de Agua, 17°30'51"N, 92°17'41"W, 70m (LLAMA); Nahá, 16°58'47"N, 91°35'08"W, 860m (LLAMA); 15km ENE Huixtla, 15°11'N, 92°20'W, 1200m (I. Perfecto).

## *Pheidole radoszkowskii*

*Pheidole radoszkowskii* Mayr, 1884: 35. Lectotype major worker (here designated, as labeled by Wilson 2003) and paralectotype minor worker: Cayenne [NHMW] (examined). Senior synonym of *acuta*, *australis*, *luteola*, *opacissima*, *paranana*, *parvinoda*, *reflexans*: Wilson 2003:221.

*Pheidole medialis* Wilson, 2003: 208, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Prov. Cartago, 5km E Tres Rios, El Alto de Ochomogo (J. Welch) [MCZ] (examined). **New synonymy.**

## Comments

Wilson (2003) discussed character variation and synonymy in the widespread species *P. radoszkowskii* (a complete list of synonymy is not presented here). The species *P. medialis* is well within the range of variation for *P. radoszkowskii* in Costa Rica, and there is no evidence of discrete sympatric forms.

## *Pheidole rhinoceros*

*Pheidole rhinoceros* Forel, 1899: 73, pl. 3, fig. 23. Lectotype major worker (here designated, as labeled by Wilson 2003) and associated paralectotype minor worker: Panama, Bugaba, 800–1500ft (Champion) [MHNG] (examined).

## Geographic Range

Panama to southern Mexico.

## Biology

This species occurs in lowland wet forest habitats. Its upper elevational limit varies geographically: on the Barva Transect in Costa Rica it does not occur over 500m elevation. It occurs as high as 800m elevation in the Peñas Blancas Valley in the Cordillera de Tilarán, and it has been collected at 1100m on Volcan Cacao, an isolated peak in the Cordillera de Guanacaste. Nests are in dead wood on the forest floor, under loose bark, and occasionally in live stems (nests have been collected in live stems of *Myriocarpa* [Urticaceae] and the

petiolar domatia of *Piper cenocladum* [Piperaceae]). Surprisingly, given the moderately common discovery of nests when general collecting, workers rarely recruit to baits and are rarely collected in Winkler or Berlese samples.

### Comments

Two similar species have been conflated under this name until now. Wilson (2003) examined the lectotype of *P. rhinoceros* but later used specimens of the similar *P. rhinomontana* (described below) for illustrations. See further discussion and diagnostic characters under *P. rhinomontana*.

*Pheidole unicornis* Wilson 2003 is not currently separable from *P. rhinoceros*, but I defer synonymy pending additional study. In Central America, *P. rhinoceros* is a lowland species and *P. rhinomontana* is a parapatric replacement species at higher elevations. Unlike this pattern, *P. unicornis* has the morphology of *P. rhinoceros* but was collected at 2100m near Cali, Colombia. The minor workers appear somewhat more robust than the typical *P. rhinoceros* from Costa Rica.

### *Pheidole rhinomontana* new species

Figure 20

*Pheidole rhinoceros* (part): Wilson, 2003:738, fig. [misidentification].

**Holotype major worker.** Costa Rica, Alajuela: Peñas Blancas Valley, Guindon cabin, 10.30000°N 84.70000°W, ±2000m, 940m, 5 Jul 1984 (J. Longino#5Jul84/0854) [INBC, unique specimen identifier CASENT0610082].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, FMNH, INBC, LACM, MCZ, MHNG, MIZA, MZSP, UCD, ICN, USNM].

### Geographic Range

Costa Rica, Panama.

### Diagnosis

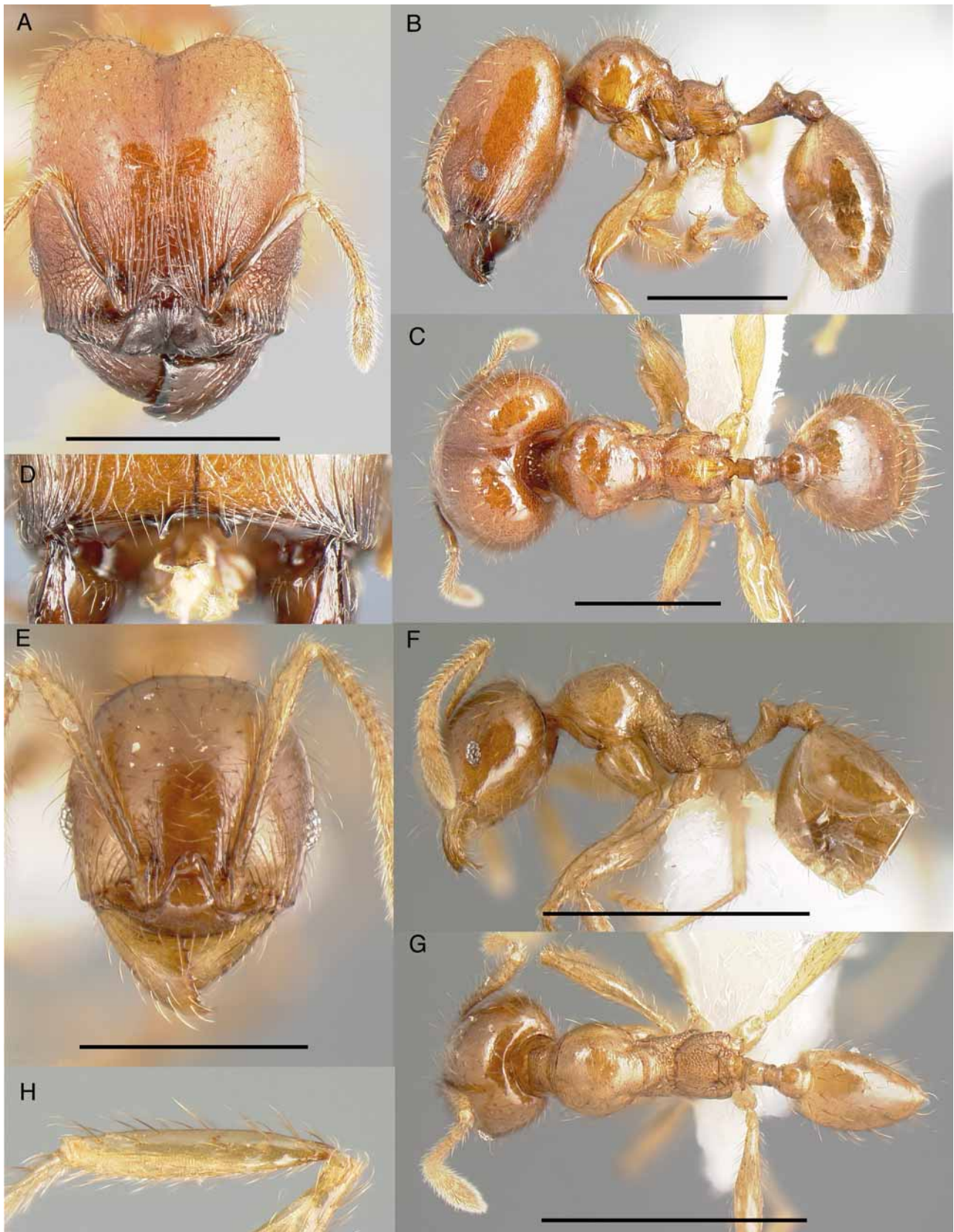
With the habitus and morphometric profile of *P. rhinoceros*. Minor worker: katapisternum largely foveolate *versus* smooth and shining (*rhinoceros*). Major worker: basal one third to one half of mandible coarsely striate *versus* largely smooth and shining; clypeus usually with longitudinal to oblique rugulae lateral to medial horn *versus* clypeus completely smooth and shining lateral to medial horn (*rhinoceros*).

### Description of minor worker

*Measurements* (paratype): HL 0.60, HW 0.56, HLA 0.21, SL 0.55, EL 0.11, ML 0.77, PSL 0.03, PMG 0.00, SPL 0.03, PTW 0.08, PPW 0.14, CI 94, SI 97, PSLI 5, PMGI 0, SPLI 5, PPI 175.

*Measurements* (n=9): HL 0.54–0.65, HW 0.50–0.60, SL 0.50–0.59, CI 90–94, SI 97–105.

Mandible smooth and shining; clypeus smooth and shining with faint medial longitudinal carina; face largely smooth and shining with variable degree of concentric carinulae around antennal insertion and faint foveolate sculpture between frontal carinae and compound eye; margin of vertex rounded with slight median impression; occipital carina narrow, not or barely visible in full face view; scape with abundant erect setae, longest about as long as maximum width of scape; promesonotal groove absent; propodeal spines present; pronotum smooth and shiny dorsally and laterally, with foveolae on humerus and strip of foveolae and transverse carinulae anterodorsally; katapisternum largely to entirely foveolate; sides and dorsum of propodeum foveolate; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with abundant suberect setae, longest about as long as maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with abundant erect setae; color red brown.



**FIGURE 20.** *Pheidole rhinomontana*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.



## Description of major worker

*Measurements* (holotype): HL 1.55, HW 1.32, HLA 0.40, SL 0.64, EL 0.17, ML 1.33, PSL 0.09, PMG 0.01, SPL 0.05, PTW 0.21, PPW 0.38, IHT 0.21, OHT 0.58, CI 85, SI 48, PSLI 6, PMGI 1, SPLI 3, PPI 180, HTI 35.

*Measurements* (n=10): HL 1.29–1.74, HW 1.12–1.44, SL 0.60–0.71, CI 83–87, SI 48–53.

Mandible with coarse longitudinal rugae on basal one third to one half, remaining surface smooth; medial clypeus forming a differentiated, somewhat concave surface, sharply delimited by strong oblique carinae extending from anterior apices of frontal carinae; clypeus obsolete or absent lateral to these carinae, not differentiated from coarsely rugose anterior head capsule; medial clypeus with a pronounced acute laminar horn; usually with several weak longitudinal to oblique carinulae on the clypeal surface lateral to horn; anterior clypeal margin flat to weakly emarginate; anterolateral head capsule with longitudinal rugae, grading to reticulate rugae over foveolae between antennal insertion and compound eye, grading to faint foveolate sculpture on scrobal area beneath scapes, grading to smooth and shining on vertex lobes; area between frontal carinae with longitudinal carinulae; head with abundant suberect setae projecting from sides of head in face view; scape smooth and shining, terete at base, with abundant erect setae about as long as maximum width of scape; hypostomal margin flat; median tooth absent; inner hypostomal teeth pointed, stout, closer to midline than to outer hypostomal teeth; promesonotal groove absent; propodeal spines present; mesosoma largely smooth and shining, with faint transverse etchings on pronotum, faint foveolate sculpture on dorsal face of propodeum; dorsal (outer) margin of hind tibia with abundant erect setae, these not quite as long as maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiolar dorsum smooth and shining, in dorsal view broader than long, weakly conulate; first gastral tergite smooth and shining, with abundant erect setae; color red brown.

## Biology

This species inhabits mature montane wet forest habitats, from 500–1600m elevation. Workers are frequently visitors at baits on the ground and are common in Winkler samples of sifted leaf litter. Nests are in or under dead wood on the ground, often in shallow chambers near the surface or under loose bark. Incipient colonies with single queens are often encountered, and colonies can become quite populous.

## Etymology

The name is in reference to this species being a montane version of *P. rhinoceros*.

## Comments

Wilson (2003) discussed character variation in a broadly-defined *P. rhinoceros*. New evidence supports the existence of two sharply parapatric species that separate by elevation. The morphological differences outlined in the Diagnosis are subtle but consistent. There are now two known areas where the two species co-occur in the same forest. On the Atlantic slope of the Cordillera de Tilarán in Costa Rica, both species were collected at a single bait line at the Poco Sol field station at the lower end of the Peñas Blancas valley, at 800m elevation. At Refugio Eladio, further up the valley but at about the same elevation, extensive collections have yielded only *P. rhinomontana*. In Monteverde, in the cloudforest-covered ridges that rise to 1800m at the head of the valley, only *P. rhinomontana* occurs. On the Barva Transect on the Atlantic slope of the Cordillera Volcánica Central, *P. rhinoceros* is common from La Selva Biological Station at 50m to the El Ceibo Station at 500m. Both species co-occur at this elevation. At the 1070m station and above only *P. rhinomontana* occurs. This pattern may also occur as far north as Honduras and south into Panama. Although specimen data were not captured, a visit to the MCZ revealed Honduras specimens of *P. rhinoceros* from a 650m elevation site and Honduras specimens of *P. rhinomontana* from a 1040m elevation site. In Panama, the type specimens of *P. rhinoceros* are from Bugaba, below 500m elevation, while the MCZ specimens of *P. rhinomontanus* examined by Wilson were from Volcán Chiriquí, 900m, and Cerro Campana, 800–950m.

### Additional material examined

COSTA RICA: Alajuela, Casa Eladio, Rio Peñas Blancas, 10°19'N, 84°43'W, 800m (J. Longino); Poco Sol, 10°20'44"N, 84°40'28"W, 800m (J. Longino); Guanacaste, 3km N Santa Elena, 10°20'N, 84°50'W, 1500m (R. Burtoft); Heredia, 16km SSW Pto. Viejo, 10°19'03"N, 84°02'56"W, 500m (TEAM); 16km N Vol. Barba, 10°16'N, 84°05'W, 1020m (J. Longino); 17km N Vol. Barba, 10°17'N, 84°05'W, 800m (J. Longino); 10km SE La Virgen, 10°20'N, 84°05'W, 500m (August Longino and Lisa Schonberg); 16km SSE La Virgen, 10°16'N, 84°05'W, 1100m (J. Longino) Vara Blanca, 10km NE Vara Blanca, 10°14'00"N, 84°05'00"W, 1500m (J. Longino); Puntarenas, Monteverde, 10°18'N, 84°48'W, 1500m (J. Longino); Wilson Botanical Garden, 4km S San Vito, 8°47'N, 82°58'W, 1200m (L&A Alonso).

### *Pheidole sculptior*

*Pheidole flavens* r. *sculptior* Forel, 1893: 414. Lectotype major worker (here designated, as labeled by Wilson 2003) and associated paralectotype minor worker, queen: Antilles Islands, St. Vincent (H. H. Smith) [lectotype at MCZ] (lectotype examined). Wilson, 2003: 506: raised to species.

*Pheidole tayrona* Wilson, 2003: 518, figs. Holotype major worker and associated paratype minor worker: Colombia, Magdalena, Tayrona Park, Pueblito to S. park boundary, 1977 (C. Kugler) [MCZ] (examined). **New synonymy.**

### Comments

The types of *P. sculptior* and *P. tayrona* were directly compared and there is no substantial difference.

### *Pheidole sebofila* new species

Figure 21

**Holotype major worker.** Costa Rica, Heredia: Rara Avis, 17km S Pto. Viejo, 10.30000°N 84.05000°W, ±2000m, 700m, 11 Sep 1985 (J. Longino#1064) [INBC, unique specimen identifier INBIOCRI001282230].

**Paratypes:** major and minor workers. Same data as holotype; Costa Rica, Alajuela: Casa Eladio, Rio Peñas Blancas, 10.31667°N 84.71667°W, ±2000m, 800m, 7 Mar 2002 (J. Longino#4643) [INBC, JTLC, MCZ].

### Geographic Range

Costa Rica.

### Diagnosis

With the morphometric profile and general habitus of *P. indagatrix*. Minor worker: dorsal portion of occipital carina reduced relative to lateral portions, such that in lateral view the carina not projecting, *versus* occipital carina similarly developed dorsally and laterally, such that in lateral view it is visible as a distinct lip or flange projecting from posterior head; propodeal spines relatively long, PSLI 17, *versus* spines shorter, PSLI < 13 (*indagatrix*). Major worker: face orange *versus* dark red brown; posterior one third to one half of face smooth and shining *versus* foveolate sculpture on face extends to or nearly to posterior margin (*indagatrix*).

### Description of minor worker

*Measurements* (paratype): HL 0.85, HW 0.72, HLA 0.31, SL 1.22, EL 0.20, ML 1.14, PSL 0.15, PMG 0.04, SPL 0.05, PTW 0.13, PPW 0.20, CI 85, SI 169, PSLI 17, PMGI 4, SPLI 6, PPI 160.

*Measurements* (n=9): HL 0.81–0.90, HW 0.64–0.72, SL 1.13–1.28, CI 78–81, SI 168–188.

Mandible smooth and shining; clypeus smooth and shining; patch of rugose foveolate sculpture between frontal carina and compound eye, rest of face smooth and shining; margin of vertex trapezoidal; occipital

carina moderately developed as a distinct flange, visible in full face view, more strongly developed laterally than dorsally, such that in lateral view the carina not projecting; scape with abundant erect setae longer than maximum width of scape; promesonotal groove present; propodeal spines present, long, thin, upturned; pronotum smooth and shining; anepisternum, katepisternum, dorsal face of propodeum, and upper lateral face of propodeum foveolate; metapleural bulla smooth and shining, with two strong carinae; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with suberect setae, the longest longer than maximum width of tibia; first gastral tergum smooth and shining; gastral dorsum with abundant erect setae; color red brown.

### **Description of major worker**

*Measurements* (holotype): HL 1.70, HW 1.59, HLA 0.50, SL 1.26, EL 0.26, ML 1.58, PSL 0.13, PMG 0.05, SPL 0.09, PTW 0.22, PPW 0.39, CI 94, SI 79, PSLI 8, PMGI 3, SPLI 5, PPI .

*Measurements* (n=2): HL 1.56–1.70, HW 1.50–1.59, SL 1.16–1.26, CI 94–96, SI 77–79.

Mandibles smooth and shiny; clypeus smooth and flat with strong anterior notch; frontal carina elevated as vertical flange; anterolateral face with short longitudinal rugae, grading to reticulate rugae underlain by weak foveolate sculpture between frontal carina and compound eye, grading to foveolate sculpture with faint rugulae on scrobal area, grading to smooth and shining on posterior half to third of head, area between frontal carinae with rugose foveolate sculpture laterally, grading to smooth and shining medially, irregular faint patches of foveolate sculpture on posteromedian face (major worker collection from Peñas Blancas Valley has posterior half of face completely smooth and shining); head with abundant suberect to subdecumbent setae projecting from sides of head in face view; scape smooth and shining, terete at base, with abundant erect setae, the longest of which longer than maximum width of scape; hypostomal margin straight; median tooth absent or a broad, low gibbosity; inner hypostomal teeth thin and sharp, much closer to outer hypostomal teeth than to midline; promesonotal groove present; propodeal spines present; pronotum generally shining with areas of faint foveolae; katepisternum largely foveolate, grading to smooth and shiny anteroventrally; dorsal face and upper lateral face of propodeum foveolate, metapleural bulla smooth and shining with one to three longitudinal carinae; dorsal (outer) margin of hind tibia with abundant suberect setae longer than maximum width of tibia; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view wider than long, with rounded sides; first gastral tergite with nearly effaced foveolate sculpture anteriorly (a microsculptural mesh), grading to smooth and shining posteriorly, with abundant erect setae; color somewhat bicolored, with orange head and mesosoma, dark brown gaster.

### **Biology**

This species is known from wet forest sites on the Atlantic slope of the Cordillera de Tilarán and the Cordillera Volcánica Central, from 500–1100m elevation. Two collections with major workers have been from baits on the forest floor (one at the edge of a stream). Minor workers have been collected in Winkler samples, pan traps, sweep samples, and as nocturnal foragers.

### **Etymology**

The name means "bait lover."

### **Comments**

This species is very similar to the common *P. indagatrix* that is found in the same areas and habitats.

### **Additional material examined**

COSTA RICA: Heredia, 11km SE La Virgen, 10°20'N, 84°04'W, 500m (S. Brooks, M. Pollet); 16km SSE La Virgen, 10°16'N, 84°05'W, 1100m (multiple collectors and collections).



**FIGURE 21.** *Pheidole sebofila*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–D, Holotype major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, 1mm for others.

## *Pheidole sparsisculpta* new species

Figure 22

**Holotype major worker.** Costa Rica, Heredia: 16km SSE La Virgen, 10.26667°N 84.08333°W, ±2000m, 1100m, 20 Feb 2001 (ALAS#11/B/BH/047) [INBC, unique specimen identifier INB0003214434].

**Paratypes:** major and minor workers. Same data as holotype; same locality as holotype but 14 Mar 2001 (ALAS#11/WF/02/19), 19 Mar 2001 (ALAS#11/WF/03/19); Costa Rica, Heredia: 16km SSW Pto. Viejo, 10.31750°N 84.04889°W, ±500m, 500m, 20 Apr 2007 (Gilberth H and Felix C.#AMI-3-W-135-06) [FMNH, INBC, JTLC, MCZ, USNM].

### Geographic Range

Costa Rica.

### Diagnosis

With the morphometric profile and general habitus of *P. debilis*. Minor worker: face and mesosoma with extensive smooth areas *versus* completely foveolate (*debilis*). Major worker: posterior fourth of face smooth and shining *versus* vertex lobes with faint reticulate rugose-foveolate sculpture extending almost to posterior border (*debilis*).

### Description of minor worker

*Measurements* (paratype): HL 0.51, HW 0.46, HLA 0.17, SL 0.44, EL 0.08, ML 0.57, PSL 0.07, PMG 0.00, SPL 0.03, PTW 0.08, PPW 0.13, CI 91, SI 95, PSLI 14, PMGI 0, SPLI 6, PPI 159.

*Measurements* (n=10): HL 0.45–0.54, HW 0.41–0.49, SL 0.39–0.47, CI 90–93, SI 93–98.

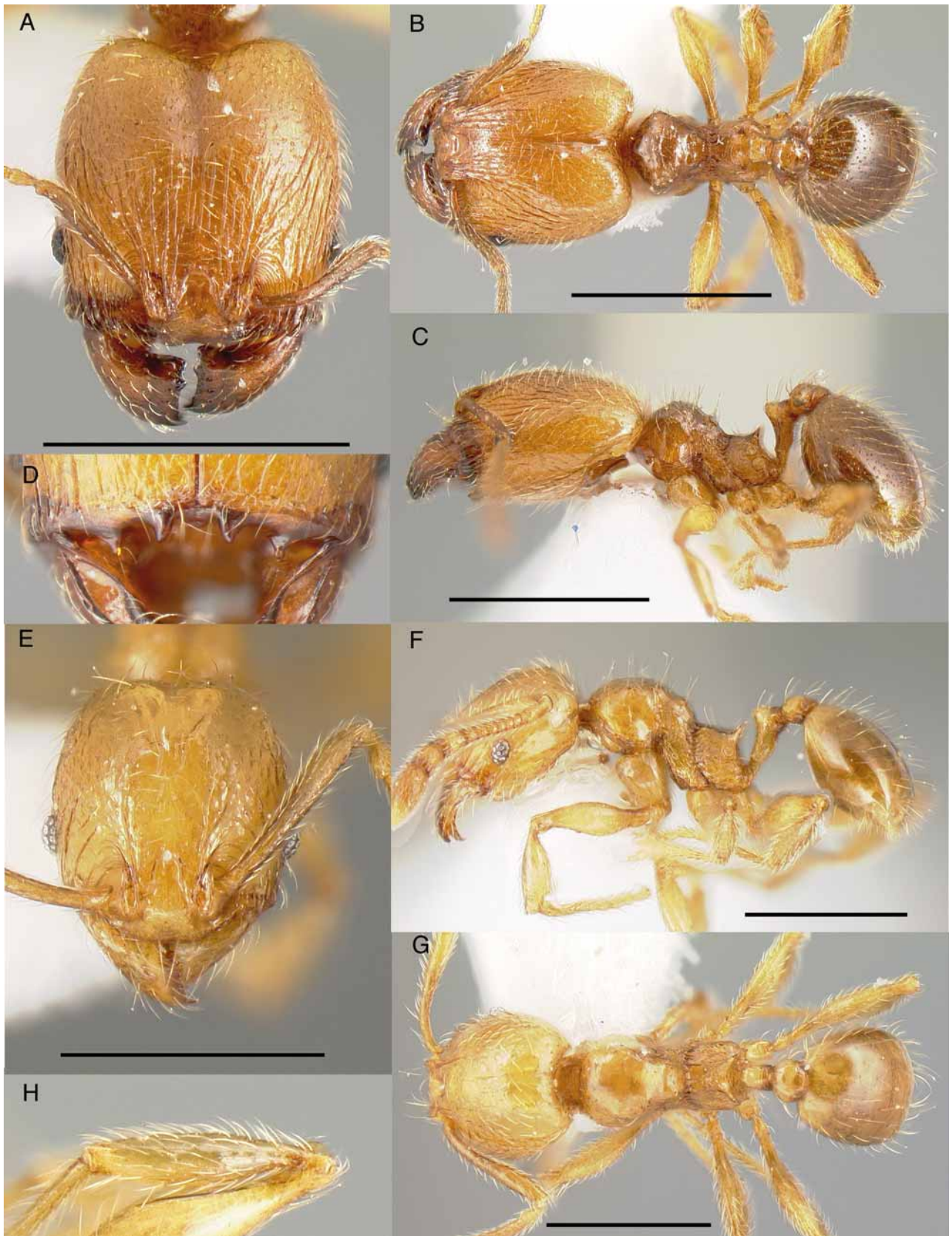
Mandible and clypeus smooth and shining; face sculpture highly variable, largely smooth and shining with variable development of weak rugulae and foveolae; posterior margin of vertex flattened; occipital carina narrow, not visible in full face view; scape with abundant subdecumbent setae, none of which are longer than maximum width of scape; promesonotal groove very shallow, indistinct; propodeal spines present; mesosoma sculpture similar to face in variability, generally shiny, pronotum entirely smooth and shiny or with faint rugulae and foveolae, katapisternum and lateral and dorsal faces of propodeum faintly foveolate; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with abundant subdecumbent pilosity, all shorter than maximum width of tibia, no long erect setae; first gastral tergum smooth and shining; gastral dorsum with abundant erect setae; color orange.

### Description of major worker

*Measurements* (holotype): HL 1.05, HW 0.95, HLA 0.29, SL 0.52, EL 0.12, ML 0.75, PSL 0.09, PMG 0.01, SPL 0.06, PTW 0.15, PPW 0.34, IHT 0.17, OHT 0.41, CI 91, SI 55, PSLI 9, PMGI 1, SPLI 6, PPI 226, HTI 40.

*Measurements* (n=2): HL 1.03–1.05, HW 0.95–0.97, SL 0.48–0.52, CI 91–94, SI 50–55.

Mandibles smooth and shiny; clypeus smooth and shallowly concave, with shallow anterior notch; face with widely-spaced longitudinal rugulae on cheeks and between frontal carinae, fading to smooth and shiny on posterior third of face; head with abundant suberect setae projecting from sides of head in face view; scape smooth and shining, terete at base, with subdecumbent pubescence and scattered longer suberect setae; hypostomal margin flat; median tooth small; inner hypostomal teeth pointed, stout, closer to midline than to outer hypostomal teeth; promesonotal groove impressed; propodeal spines present; pronotum largely smooth and shining, with a few transverse carinulae dorsally; katapisternum and propodeum generally shiny, with a few irregular rugulae and patches of faint foveolae; dorsal (outer) margin of hind tibia with short decumbent pilosity, no long erect hairs; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view strongly transverse, with prominent lateral conules; first gastral tergite smooth and shining, with abundant flexuous erect setae; color orange brown.



**FIGURE 22.** *Pheidole sparsisculpta*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–D, Holotype major worker; E–H, Paratype minor worker. Scale bar 0.5mm for E, F, G, 1mm for others.

## Biology

This species occurs in mature wet forest, from 50–1100m elevation. It is only known from the Barva Transect in Braulio Carrillo National Park, Costa Rica. Minor workers are moderately abundant in Winkler and Berlese samples of leaf litter from the forest floor, and there are occasional major workers associated with the minors.

## Etymology

The name is in reference to the sparse sculpture of the minor worker, compared to the similar *P. debilis*.

## Comments

Sequence data from the "dna barcode" region of mitochondrial gene CO1 place this species very close to or even within *P. debilis*. Thus this is a situation worth further investigation, where there appear to be two morphological clusters in sympatry, yet sequence data suggest conspecificity.

## Additional material examined

COSTA RICA: Heredia, 7km SW Pto. Viejo, 10°24'N, 84°02'W, 160m (multiple collectors and collections); Cantarrana, 11km ESE La Virgen, 10°20'43"N, 84°03'28"W, 300m (multiple collectors and collections).

## *Pheidole susannae*

*Pheidole susannae* Forel, 1886: xliii. Syntype major, minor worker: Guatemala, Retalhuleu (Stoll) [MHNG] (examined).

*Pheidole susannae* r. *obscurior* Forel, 1886: xliv. Lectotype major worker (here designated, labeled with unique pin code JTLC000015316) and associated paralectotype minor worker: Brazil, Rio de Janeiro (Naegeli) [MHNG] (examined). Forel, 1893: 410: description of queen, male. Wilson, 2003: 330: raised to species, senior synonym of *P. partita*. **New Synonymy.**

*Pheidole partita* Mayr, 1887: 590 (major worker), 604 (minor worker): Brazil, Rio de Janeiro (Naegeli). Wilson, 2003: 330: junior synonym of *P. obscurior*. **New Synonymy.**

*Pheidole susannae* r. *atricolor* Forel, 1901a: 356. Syntype major, minor worker, gyne, male: Colombia, Magdalena, San Antonio (Forel) [MHNG] (examined). Wilson, 2003: 351: junior synonym of *P. susannae*.

*Pheidole incisa* subsp. *evoluta* Borgmeier, 1929: 204, pl. 6, fig. 3. Syntype major, minor worker: Brazil, Rio Grande do Sul, Porto Alegre, 30 Nov 1924 (Buck). Kempf, 1964: 63: junior synonym of *P. susannae*.

## Geographic Range

Southern Mexico to southern Brazil.

## Biology

This species occurs in various habitats, including highly disturbed areas (city parks), seasonal dry forest, mature lowland rainforest, and second growth rainforest. It can occur on the ground or in the canopy. Workers readily recruit to baits, and major workers often recruit along with minor workers. Nests are in small cavities and appear to be somewhat opportunistically inhabited.

## Comments

Although Wilson (2003) illustrated a "Lectotype major worker," among the type material of *P. susannae* borrowed from MHNG for this study, none was labeled Lectotype.

The syntypes of *P. susannae* and *P. obscurior* are very similar in all respects but color. The syntypes of *P. susannae* are yellow; those of *P. obscurior* are dark brown. The key in Wilson separates the species on relative scape length in the major, with *P. obscurior* purported to have relatively longer scapes. However, measurements of the types reveal that the lectotype of *P. obscurior* has a SI that is actually lower than that of syntypes of *P. susannae*.

*Pheidole susannae* is a relatively common species found in disturbed habitats throughout the Neotropics. It appears quite uniform in morphology across its range. With the exception of the type series, all the material examined to date has been dark red brown. The types are inexplicably yellow. A yellow form may be discovered in Guatemala (the type locality), but given that the types were collected in the nineteenth century with uncertain methods of preservation, there is the possibility that the coloration is a preservation artifact.

### ***Pheidole synanthropica* new species**

Figure 23

*Pheidole indistincta* Forel, 1899: 75 (part, see *P. pubiventris*). Minor workers of a mixed syntype series: Costa Rica (Tonduz) [MHNG] (examined).

**Holotype major worker.** Costa Rica, Guanacaste: Bosque Humedo, Santa Rosa Nat. Park, 10.85000°N 85.61667°W, ±2000m, 300m, 15 Jul 1985 (J. Longino#0511) [INBC, unique specimen identifier CASENT0609037].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, FMNH, INBC, JTLC, LACM, MCZ, MZSP, UCD, USNM].

### **Geographic Range**

Costa Rica, Mexico (Chiapas).

### **Diagnosis**

With the general habitus of *P. anima* Wilson 2003, *P. eidmanni* Menozzi 1926, *P. maja* Forel 1886, *P. piceonigra* Emery 1922, and *P. texticeps* Wilson 2003. Minor worker: scape relatively short, SI 102–116, *versus* relatively longer, SI > 120 (*anima*, *maja*, *piceonigra*, *texticeps*); katapisternum foveolate, lacking irregular rugulae, *versus* with irregular rugulae overlaying foveolate sculpture (*anima*). Major worker: base of scape terete *versus* base of scape flattened (*anima*, *maja*, *piceonigra*); scape with no erect setae *versus* about 3 erect setae (*texticeps*); face with erect setae totally absent to very sparse *versus* with 10 or more erect setae (*anima*); anterior face with very reduced rugose sculpture *versus* with more extensive rugoreticulum (*eidmanni*, based on illustration of the major worker in Wilson [2003:289]); katapisternum sculpture as in minor worker; postpetiole in dorsal view robust, with strong triangular lateral conules, *versus* less transverse, with rounded, not conulate sides (*anima*); gaster with no erect setae *versus* with more than 5 erect setae (*anima*, *texticeps*).

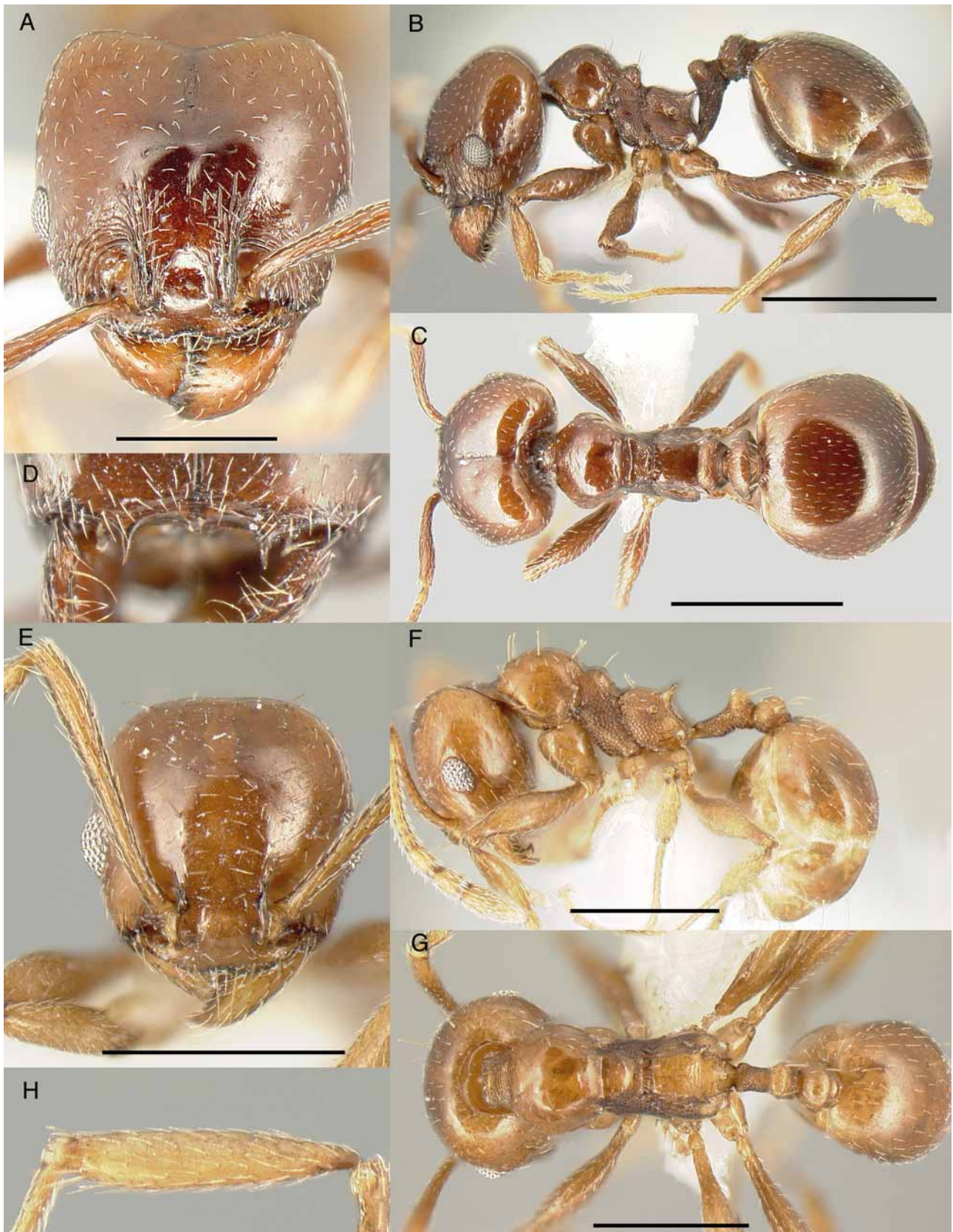
### **Description of minor worker**

*Measurements* (paratype): HL 0.59, HW 0.56, HLA 0.21, SL 0.62, EL 0.15, ML 0.71, PSL 0.08, PMG 0.02, SPL 0.04, PTW 0.12, PPW 0.17, CI 96, SI 110, PSLI 13, PMGI 4, SPLI 6, PPI 141.

*Measurements* (n=16): HL 0.59–0.69, HW 0.56–0.66, SL 0.62–0.68, CI 91–98, SI 102–116.

Face uniformly smooth and shining; posterior margin of vertex flattened; occipital carina narrow, not visible in full face view; scape with short appressed to subdecumbent pubescence and 0–3 longer suberect setae; promesonotal groove large, deeply impressed; propodeal spines present; pronotum and dorsal mesonotum smooth and shining; katapisternum, anepisternum, and side of propodeum foveolate; dorsal face of propodeum faintly foveolate; setae on mesosoma short and stiff, four pairs on pronotum, one pair on mesonotum, and one forward-slanting pair on propodeum; dorsal (outer) margin of hind tibia with short fully appressed to subdecumbent pilosity, 0–1 long erect hairs; first gastral tergum smooth and shining; gastral dorsum with sparse short fully appressed setae and sparse longer erect setae, appressed setae much shorter than distance among them; color brown.





**FIGURE 23.** *Pheidole synanthropica*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for A, E, F, G, 1mm for others.

## Description of major worker

*Measurements* (holotype): HL 1.00, HW 1.03, HLA 0.31, SL 0.66, EL 0.21, ML 0.99, PSL 0.10, PMG 0.04, SPL 0.05, PTW 0.30, PPW 0.43, IHT 0.33, OHT 0.44, CI 104, SI 64, PSLI 10, PMGI 4, SPLI 5, PPI 144, HTI 74.

*Measurements* (n=6): HL 0.91–1.00, HW 0.88–1.03, SL 0.63–0.66, CI 97–104, SI 64–71.

Mandibles smooth and shiny; clypeus smooth and flat with distinct anterior notch; face with a few concentric rugulae around antennal insertions but otherwise smooth and shiny throughout; face with sparse, fully appressed, short setae, shorter than the distance among them, erect setae totally absent to very sparse, 0–2 pairs on frontal carinae, 0–1 pair on clypeus; scape smooth and shining, terete at base, with no erect setae; hypostomal margin gently curved; median tooth small; inner hypostomal teeth acutely pointed, much closer to outer hypostomal teeth than to midline; promesonotal groove prominent, deeply impressed; propodeal spines present; mesosomal sculpture as in minor worker; dorsal (outer) margin of hind tibia with short decumbent pilosity, no long erect hairs; mesosomal dorsum with erect setae sparse to absent, 0–1 pair on posterior pronotum, 0–1 pair on mesonotum; petiolar node in dorsal view transverse, much broader than long; postpetiole in dorsal view robust, with strong triangular lateral conules; first gastral tergite smooth and shining, with sparse short appressed setae and no erect setae; color brown.

## Biology

*Pheidole synanthropica* occurs in open, seasonally dry habitats. The type specimens were at a tuna bait in the "bosque humedo" of Santa Rosa National Park in Costa Rica, but all other collections have been from highly synanthropic habitats such as city parks, lawns, and coffee farms.

## Etymology

The name is in reference to this species' occurrence in open, highly disturbed areas, often near human habitation.

## Comments

The syntype series of *P. indistincta* was comprised of two different Tonduz collections later associated by Forel. The labels are spare, just "Costa Rica, Tonduz," but the minor worker series has a number 1 on the label and the lectotype major worker has a number 3 on the label. These are probably different collection events and are definitely two different species. The minor workers are *P. synanthropica* and the lectotype major is *P. pubiventris*, another widespread and highly synanthropic species.

Tonduz was one of the early naturalists in Costa Rica, working with Anastasio Alfaro at the National Museum and sending abundant ant collections to taxonomists in Europe. Most of his collections are species of forested habitats, but it is perhaps telling that what might be his first collections, with collection numbers 1 and 3, are two ant species common in urban areas in the Central Valley. I have collected *P. synanthropica* in city parks just a few blocks from the National Museum where Tonduz worked. I can imagine a young Tonduz being sent out behind the museum to collect his first ants.

It is remarkable that this species is not better known and just now being described. It is no doubt common throughout the highly urbanized central valley of Costa Rica, and, since it also occurs in coffee farms in the Sierra Madre de Chiapas in southern Mexico, probably occurs in similar areas throughout Central America. This is probably a case of the common ants in the back yard being ignored as eager collectors head for undisturbed forest.

## Additional material examined

COSTA RICA: Heredia, Santo Domingo, 9°59'N, 84°05'W, 1100m (I. Perfecto); Puntarenas, 6km S Monteverde, 10°15'N, 84°49'W, 800m (J. Longino); Est. Biol. Los Llanos, near Santa Elena, 10°18'18"N, 84°50'14"W, 1150m (J. Longino); Monteverde, 10°18'N, 84°48'W, 1400m (S. Koptur); San José, Loma San Antonio, nr San Jose, 9°54'N, 84°02'W, 1300m (J. Longino); San Jose, 9°56'N, 84°05'W, 1100m (J. Longino); MEXICO: Chiapas, 15km ENE Huixtla, 15°11'N, 092°20'W, 1200m (I. Perfecto).



**FIGURE 24.** *Pheidole tenuicephala*. Major worker: A, face view; B, lateral view; C, dorsal view; D, hypostomal margin. Minor worker: E, face view; F, lateral view; G, dorsal view; H, hind tibia. A–C, Holotype major worker; D, non-type major worker; E–H, Paratype minor worker. Scale bar 0.5mm for A, E, 1mm for others.

## *Pheidole tenuicephala* new species

Figure 24

**Holotype major worker.** Costa Rica, Puntarenas: Monteverde, 10.30000°N 84.80000°W, ±2000m, 1400m, 21 Jun 1999 (J. Longino#4042) [INBC, unique specimen identifier CASENT0609054].

**Paratypes:** major and minor workers. Same data as holotype [BMNH, CAS, FMNH, INBC, JTLC, LACM, MCZ, MHNG, MIZA, MZSP, UCD, USNM].

### Geographic Range

Costa Rica.

### Diagnosis

With the habitus of *P. madrensis* and *P. mooreorum*. **Minor worker:** head relatively narrow, CI 79–85, *versus* broader, CI > 83 (*madrensis*, *mooreorum*); vertex margin rounded *versus* flattened (*madrensis*) (variable in *mooreorum*); pronotum completely smooth and shining *versus* with mixture of smooth shiny areas and faint foveolate sculpture (*madrensis*); pilosity relatively longer and more abundant *versus* shorter and sparser (*madrensis*). **Major worker:** head relatively narrow, CI 82–88, *versus* broader, CI > 89 (*madrensis*, *mooreorum*); face almost entirely smooth and shining *versus* with rugose foveate sculpture extending over anterior two thirds to three fourths (*madrensis*).

This is a Costa Rican variant of the *P. mooreorum* complex. The very narrow head of the major worker, with nearly flat sides, is highly distinctive within the complex.

### Description of minor worker

*Measurements* (paratype): HL 0.76, HW 0.63, HLA 0.28, SL 0.76, EL 0.15, ML 0.94, PSL 0.06, PMG 0.02, SPL 0.03, PTW 0.12, PPW 0.17, CI 83, SI 121, PSLI 8, PMGI 3, SPLI 4, PPI 137.

*Measurements* (n=10): HL 0.68–0.76, HW 0.55–0.63, SL 0.73–0.86, CI 79–85, SI 121–143.

Mandible, clypeus, and face smooth and shining; margin of vertex rounded; occipital carina narrow, not visible in full face view; scape with abundant erect setae longer than maximum width of scape; promesonotal groove present, conspicuous; propodeal spines present; pronotum largely smooth and shining with narrow region of faint foveolae and rugulae on anterior margin; katapisternum, lateral face of propodeum, and dorsal face of propodeum foveolate; abundant setae on promesonotal dorsum; dorsal (outer) margin of hind tibia with abundant, long, suberect setae; first gastral tergum smooth and shining; gastral dorsum with abundant, long, suberect setae; color dark red brown.

### Description of major worker

*Measurements* (holotype): HL 1.30, HW 1.14, HLA 0.36, SL 0.71, EL 0.18, ML 1.15, PSL 0.04, PMG 0.03, SPL 0.04, PTW 0.19, PPW 0.25, IHT 0.42, OHT 0.48, CI 88, SI 62, PSLI 3, PMGI 2, SPLI 3, PPI 131, HTI 88.

*Measurements* (n=6): HL 1.20–1.30, HW 1.04–1.14, SL 0.69–0.74, CI 82–88, SI 62–71.

Mandibles smooth and shiny; clypeus smooth and flat with strong anterior notch; face with longitudinal rugae from anterior margin to about level of compound eye and antennal insertion, rest of head completely smooth and shining; head with abundant short subdecumbent setae projecting from sides of head in face view; scape smooth and shining, terete at base, with abundant suberect setae about as long as maximum width of scape; hypostomal margin gently curved, hypostomal sclerite narrow, meeting genal bridge at obtuse angle; median tooth absent; inner hypostomal teeth sharply pointed, widely-spaced, much closer to outer hypostomal teeth than to midline; promesonotal groove present, conspicuous; propodeal spines present; pronotum smooth and shiny, katapisternum and propodeum generally shiny, with irregular rugulae and foveolae; dorsal (outer) margin of hind tibia with abundant suberect setae subequal in length to maximum length of tibia; pilosity abundant on mesosomal dorsum; postpetiole in dorsal view globular, sides rounded; first gastral tergite smooth and shining, with abundant suberect setae; color dark red brown.

## Biology

*Pheidole tenuicephala* occurs in cloud forest habitats on the Cordillera Volcánica Central and the Cordillera de Tilarán in Costa Rica. On the Barva Transect it is a narrow elevation specialist, being common at 1100m elevation, but not recorded from 1500m or 500m collecting sites. In the Cordillera de Tilarán collections have been made from 800–1400m elevation. Workers have been collected in Winkler samples, Malaise traps, pan traps, at cookie baits, and as foragers in a refuge clearing. Minor and major workers recruit to cookie baits. A nest was found beneath a stone in the lower Bajo del Tigre forest of Monteverde, a moist forest area just below the continental divide on the upper Pacific slope of the Cordillera de Tilarán.

## Etymology

The name is in reference to the relatively narrow head of the major worker.

## Additional material examined

COSTA RICA: Alajuela, Poco Sol, 10°20'44"N, 84°40'28"W, 800m (J. Longino); Heredia, 16km SSE La Virgen, 10°16'N, 84°05'W, 1100m (multiple collectors and collections).

## *Pheidole texticeps*

*Pheidole texticeps* Wilson, 2003: 240, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Heredia, La Selva Biological Station, 1988 (S. Cover) [MCZ] (examined).

*Pheidole perdiligens* Wilson, 2003: 213, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Puntarenas, Corcovado National Park, Osa Peninsula, Sirena, 28 Feb 1979, secondary rainforest, <1/2mi from coast, rotten branch on forest floor (S. P. Cover CR312) [MCZ] (examined). **New Synonymy.**

## Geographic Range

Costa Rica, Mexico (Chiapas).

## Biology

This species occurs in wet forest habitats. Workers are common on the ground and on low vegetation. They readily recruit to baits, and major workers are often at baits with minor workers. Nests are in soil, with a simple gallery leading to a chamber about 10cm deep. The two nests that have been excavated contained single queens.

## Comments

Specimens from the Atlantic slope of Costa Rica are red brown, corresponding to Wilson's *P. texticeps*, and specimens from the Osa Peninsula are yellow, corresponding to Wilson's *P. perdiligens*. Specimens from southern Mexico are yellow, like the Osa form. Other than color, these forms are indistinguishable. Until evidence from sympatry or dna sequence data suggest otherwise, these are best viewed as a single species with geographic variation in color.

## *Pheidole vorax*

*Formica vorax* Fabricius, 1804: 412. Lectotype and two paralectotype queens, here designated: Central America [ZMUC] (images examined). Roger, 1863: 30: combination in *Aphaenogaster*. Emery, 1915: 69: combination in *Pheidole*.

*Pheidole cephalica* Smith, F. 1858:177, pl. 9, figs. 21–23. Syntype major, minor worker: Brazil, Amazonas, Tunantins (Bates) [BMNH] (not examined). **New Synonymy.**

*Pheidole opaca* Mayr, 1862: 749. Syntype major, minor worker: Brazil, "Im Gebiete des Amazonenstromes" [Amazonian region] (M. C. Vienn) (not examined). Forel, 1899: 69: description of queen. Borgmeier, 1934: 97: description of queen. Kempf, 1965: 183: junior synonym of *P. cephalica*. **New Synonymy.**

- Pheidole opaca* var. *incrustedata* Forel, 1908: 59. Syntype minor worker: Costa Rica, Tuis (Pittier) [MHNG] (examined). Kempf, 1972: 188: subspecies of *P. cephalica*. Wilson, 2003: 674: junior synonym of *P. cephalica*. **New Synonymy.**
- Pheidole opaca* subsp. *sarrita* Forel, 1908: 59. Syntype minor worker: Costa Rica, Surubres, near San Mateo (Biolley) [MHNG] (examined). Kempf, 1972: 188: subspecies of *P. cephalica*. Wilson, 2003: 674: junior synonym of *P. cephalica*. **New Synonymy.**
- Pheidole opaca* subsp. *apterostigmoides* Weber, 1943: 71, fig. 3. Syntype major, minor worker: Trinidad, Basin Hill Forest Reserve, 1 Apr 1935 (Weber) (not examined). Kempf, 1972: 188: subspecies of *P. cephalica*. Wilson, 2003: 674: junior synonym of *P. cephalica*. **New Synonymy.**

### Geographic Range

Mainland Neotropics from southern Mexico to Amazon basin and Bolivia.

### Biology

This species occurs in wet to moist forest habitats. It nests in dead wood on or near the ground. Workers recruit to dead insects and other baits, and also harvest seeds. Large seed caches can be found in nests. Wilson (1987) demonstrated that minor workers were extremely sensitive to the presence of standing water. Even a few drops in the nest of a laboratory colony caused it to immediately evacuate the nest.

### Comments

Three syntype queens are in the Fabricius collection at the Natural History Museum of Denmark. Dr. L. Vilhelmsen provided images and measurements of the queens, and they match in every respect Smith's *P. cephalica*. This is a widespread and distinctive species without closely similar species with which it might be confused, so the synonymy seems secure. One of the queens has a type label, based on the informal "typification" carried out by Zimsen (1964). At the recommendation of L. Vilhelmsen, curator of the collection, the specimen with the type label is formally designated Lectotype in this paper.

There is geographic variation in sculpture and color. In Costa Rica, minor workers from Corcovado National Park in the southern Pacific lowlands have the face and mesosoma evenly foveolate, overlain with relatively weak rugae, and the color is light orange. Specimens from near Monteverde on the Pacific slope of the Cordillera de Tilarán have the face and mesosoma with coarse, abundant, reticulate rugae, these overlying a largely smooth and shining integument, and the color is light orange. This form matches closely the subspecies *P. incrustedata*. Specimens from the Peñas Blancas Valley, a short distance east of Monteverde on the Atlantic slope, are very similar but the color is darker red orange. Specimens from La Selva Biological Station and elsewhere in the Atlantic lowlands have the coarsely rugose sculpture of Monteverde specimens, but increasing underlying foveolation on the mesosoma, like the Corcovado specimens, and the color is darker red orange. This form matches the subspecies *P. sarrita*.

### *Pheidole walkeri*

- Pheidole walkeri* Mann, 1922: 27, fig. 13. Lectotype major worker (here designated, as labeled by Wilson 2003) and associated paralectotype minor worker: Honduras, San Juan Pueblo (Mann) [USNM] (MCZ major worker specimens from type series examined).
- Pheidole arietans* Wilson, 2003: 657, figs. Holotype major worker and associated paratype minor worker: Costa Rica, Heredia, La Selva Biological Station, 25 Mar 1988, mature rainforest, hollow rotten stick, seeds present (Cover, Moffett, Tobin) [MCZ] (examined). **New synonymy.**
- Pheidole glyphoderma* Wilson, 2003: 697, figs. Holotype major and associated paratype minor worker: Costa Rica, Puntarenas, Monteverde, 1500m, 25 May 1979, at sugar bait (P. S. Ward #3528-3) [MCZ] (examined). **New synonymy.**
- Pheidole triumbonata* Wilson, 2003: 771, figs. Holotype major and associated paratype minor worker: Mexico, Veracruz, 2mi W Fortin de las Flores, 3300', 6 Jan 1973, nest under bark (R. J. & A. B. Hamton) [MCZ] (image examined). **New synonymy.**

### Geographic Range

Costa Rica, Honduras, Mexico (Chiapas).

## Biology

This species is found in or near primary wet forest. Workers recruit to baits and may have seed caches in their nests. Nests are in dead wood, dead branches, and live stems. Nests have been found in live stems of *Myriocarpa* (Urticaceae) along streams and in internodes of *Cecropia* saplings. Colonies may be polydomous (e.g., in multiple separate internodes of *Cecropia* saplings). Nests occur from ground level to the canopy.

## Comments

*Pheidole walkeri* shares many characters with *P. rhinoceros*. The minor workers are nearly indistinguishable. The majors have the clypeus flat or slightly concave, but nearly always with a trace of the medial horn that is prominent in *rhinoceros*. The majors all have the dorsal surface of the mandible with very short, fully appressed setae only, no large piligerous puncta, and the base of the mandible has roughened sculpture that extends a variable distance onto the dorsal surface. *Pheidole walkeri* may well be a complex of multiple cryptic species, and the following forms can be recognized. Although the forms exhibit discordant character variation and are not cleanly separable, there is the potential for six or more cryptic species.

*Pheidole arietans*, lowland Costa Rica: minor worker with face completely smooth and shining, nearly black; katapisternum mostly smooth and shining, with foveolation restricted to ventral and posterior margins. Major worker with clypeus flat, smooth, matte, with only a trace of medial horn; sculpture on face posterior to clypeus a short series of arcing rugae that meet medially, followed by transverse rugulae; setae on sides of head suberect; medial portion of side of pronotum, almost entire katapisternum, and lateral propodeum anterior to spiracle smooth, shining, highly polished. This form occurs in the Costa Rican lowlands, from La Selva Biological Station to 500m on the Barva Transect; in the Peñas Blancas Valley at both Poco Sol station and Refugio Eladio, at 800m; and on the lower slope of Volcan Arenal at 700m.

Highland Barva Transect form, Costa Rica: minor worker face completely foveolate; somewhat lighter brown; katapisternum more extensively foveolate, with small shiny patch anterodorsally or almost entirely foveolate. Major worker with clypeus as in *arietans*; sculpture on face posterior to clypeus like *arietans*, but anterior arcing rugae may be replaced by irregular mesh of rugae; setae on sides of head suberect, like *arietans*; side of pronotum with more extensive faint rugulae crossing medial area, katapisternum with larger patch of foveolation ventrally, lateral propodeum anterior to spiracle more foveolate compared to *arietans*. This form occurs in higher elevation forest, on the Barva transect, 600–1100m.

Peñas Blancas form, Costa Rica: minor worker face faintly and irregularly rugulose foveolate (intermediate between entirely shiny face of *arietans* and fully foveolate face of highland Barva form and *P. glyphoderma*); somewhat lighter brown; sculpture on side of mesosoma similar to upland Barva form. Major worker like upland Barva form, with sculpture on side of mesosoma somewhat intermediate between that form and *arietans*. This form is known only from Refugio Eladio in the Peñas Blancas valley, at 800m, where it appears to be sympatric with *P. arietans*.

*Pheidole glyphoderma*, highland Costa Rica: minor worker same as highland Barva form. Major worker with clypeus more concave, sublucid instead of matte, with scattered faint longitudinal rugulae; medial face posterior to clypeus with entirely longitudinal rugulae that fan outward onto posterior lobes; setae on sides of head lanose, fully appressed; lateral pronotum with faint linear rugulae, katapisternum mostly smooth and shining, lateral propodeum anterior to spiracle foveolate. This form is known only from Monteverde cloud forest, at 1500m. It is rare in Monteverde, known from only two separate collections in spite of abundant collecting there.

*Pheidole triumbonata*, southern Mexico: minor worker same as *glyphoderma*. Major worker with clypeus more concave, sublucid like *glyphoderma*, medial clypeal carina more developed, extending almost entire length of clypeus on most specimens (very short and nearly obsolete in one); sculpture on face posterior to clypeus like *arietans* on most specimens, but one specimen with entirely longitudinal rugulae like *glyphoderma*; setae on sides of head suberect; sculpture on side of mesosoma like *glyphoderma*. This form is known from the type locality in Veracruz and two mid-elevation (500–1000m) sites in northern Chiapas.

*Pheidole walkeri*, lowland Honduras: minor workers of the type series were not examined, but from the illustrations in Wilson (2003) they are like *P. arietans*. Major worker with clypeus sublucid, medial clypeal carina moderately developed on one specimen, nearly obsolete on another; medial face posterior to clypeus with entirely longitudinal rugulae that fan outward onto posterior lobes; setae on sides of head subdecumbent.

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