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GEOGRAPHIC SPREAD OF *PHEIDOLE OBSCURITHORAX* (HYMENOPTERA: FORMICIDAE)

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ABSTRACT

The South American big-headed ant *Pheidole obscurithorax* was first found in North America in Mobile, Alabama in 1949. Since then, this species has also been recorded in Florida, Georgia, Mississippi, and Texas. We compiled and mapped published and unpublished specimen records of *P. obscurithorax* from >150 sites in South America and the US to evaluate the current geographic range of this species and its possible future spread. We documented the earliest known records for nine geographic areas (South American countries and US states). Site records of *P. obscurithorax* ranged 27.5 degrees of latitude (from 6.7°S to 34.2°S) in South America, and 3.5 degrees of latitude (from 28.0°N to 31.5°N) in North America. It may be that the North American populations of *P. obscurithorax* have a fairly narrow range of climatic tolerances. Earlier genetic analyses of native and exotic populations of *P. obscurithorax* found that the North America populations appear to originate from a single introduction from a population most closely related to native study populations from a stretch along the Paraná River in Argentina from Resistencia (27.5°S) to Santa Fe (31.6°S). This latitudinal range matches the current latitudinal range of *P. obscurithorax* in North America. Alternatively, the much greater latitudinal range of *P. obscurithorax* in South America suggests that exotic populations of *P. obscurithorax* may have potential for much additional expansion in North America and beyond. In South America, *P. obscurithorax* has a similar native range as the invasive fire ant *Solenopsis invicta*. In the North America, exotic populations of *P. obscurithorax* may spread like *S. invicta* has, across the southeast of the US and into the West Indies.

KEY WORDS: biogeography, biological invasion, exotic range, native range, invasive species

INTRODUCTION

The "hyperdiverse" genus *Pheidole* (Hymenoptera: Formicidae) includes more than 1000 recognized species (Bolton 2015). Several *Pheidole* species have become exotic pests, including *Pheidole megacephala* (Fabricius), *Pheidole moerens* Wheeler, and *Pheidole teneriffana* Forel (Wilson 2003, Wetterer 2011, 2012). Unfortunately, it is often difficult to distinguish among many of the different species of *Pheidole*, and numerous ant fauna studies include long lists of unidentified *Pheidole* species. As a result, determining the range of a particular *Pheidole* species can be difficult and the invasion by an exotic *Pheidole* may be easily overlooked.

Santschi (1923) described *Pheidole obscurithorax* Naves from three sites in northern Argentina. Thirty years later, Kusnezov (1953) reported that *P. obscurithorax* that had been collected on the bay front of Mobile, Alabama. Naves (1985) reported one additional record

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of *P. obscurithorax* from eastern Alabama, near the Florida border. Despite the scarcity of known records, Naves (1985) speculated that *P. obscurithorax* was "probably widely ranging in South America." Until recently, however, there were very few South American records of *P. obscurithorax* available to assess Naves' (1985) speculation about its native range.

In the past decade, *P. obscurithorax* has been reported from many additional sites in both South and North America, where it has often found to be an ecologically dominant species (LeBrun et al. 2007, Calcaterra et al. 2008, 2010). In the present study, we compiled published and unpublished records of *P. obscurithorax* in South and North America to evaluate the known geographic range of *P. obscurithorax* and speculate on its possible future spread.

TAXONOMY AND IDENTIFICATION

Santschi (1923) described *Pheidole obscurithorax* (Figs. 1 – 3) as *Pheidole fallax arenicola obscurithorax* Santschi (unavailable quadrinomial; referred to Naves' first usage of the trinomial *Pheidole fallax obscurithorax*). Wilson (2003) raised *P. obscurithorax* to full species and placed it close to seven other species: *Pheidole fallax* (from the Central America, northern South America, and the West Indies), *Pheidole gigas* (from Brazil), *Pheidole jelskii* (from the South America and the West Indies), *Pheidole puttemansi* (from Argentina and Brazil), *Pheidole roushae* (from the Central America), *Pheidole tobini* (from Peru), and *Pheidole valens* (from Brazil). Moreau (2008) constructed a phylogenetic tree of *Pheidole* that included 19 of the 103 species that Wilson (2003) placed in the *fallax* group, and found that the *fallax* species group was polyphyletic. Moreau (2008) placed *P. obscurithorax* closest to *P. jelskii*, the only other species in the analysis that was among the seven species that Wilson (2003) considered to be closely related to *P. obscurithorax*.

No doubt many *P. obscurithorax* specimen records remain hidden in the long lists of unidentified *Pheidole* species recorded in many published faunal studies, particularly from South America. In addition, it is likely that published studies have misidentified *P. obscurithorax* specimens as other species, notably *P. fallax*. Alex Wild (pers. comm.) wrote: "there are several species that are all quite similar: *obscurithorax*, *jelskii*, *bergi*, and at least two potentially undescribed species I've been calling cf. *jelskii* and cf. *obscurithorax.* Any of these might be going by "*fallax*" in the literature... In northern Argentina and Paraguay, *Pheidole jelskii* is the most commonly encountered member of the complex." Rodrigo Feitosa (pers. comm.) wrote, concerning *P. obscurithorax*, *jelskii*, and *fallax*: "Minor workers are virtually identical and even examining the majors it can be almost impossible to recognize the limits between these three species, especially in southern Brazil... I would not be surprised if these three names were merged in the future. "

In North America, however, it is simple to distinguish major workers of *P. obscurithorax* (Fig. 2) from those of any other native or exotic species of *Pheidole*. Naves (1985) wrote, concerning the major workers, that *P. obscurithorax* "is a large, very dark species over 6 mm in body length. Its characteristics, such as the heavily sculptured head and thick scape which is curved mesally and more angular laterally are unique among the *Pheidole* of North America." Minor workers of *P. obscurithorax* (Fig. 1) could be confused with those of *Pheidole dentata* Mayr, which may be found in the same habitats. However, *P. obscurithorax* minors are larger than *P. dentata* minors, have a more ovate-shaped head, and have the nuchal collar visible in full-face view.

METHODS

Using published and unpublished records, we documented the geographic range of *Pheidole obscurithorax.* We obtained unpublished site records from museum specimens in the collections of Archbold Biological Station (ABS, identified by M. Deyrup), the Mississippi Entomological Museum (MEM, identified by J. MacGown), the Museum of Comparative Zoology (MCZ, identified by S. Cover), and the Smithsonian Institution (SI, identified by B. Bolton). In addition, we used the on-line databases of Antweb (antweb.org), Global Biodiversity Information Facility (gbif.org), and

the School of Ants (schoolofants.org). We obtained unpublished site records of *P. obscurithorax* from Alex Wild (Paraguay).

We obtained geo-coordinates for collection sites from published references, specimen labels, maps, or geography web sites (e.g., earth.google.com and www.tageo.com). If a site record listed a geographic region rather than a 'point locale,' and we had no other record for this region, we used the coordinates of the largest town within the region or, in the case of small islands and natural areas, the center of the region.

Photomicrographs (Figs. 1 – 3) were taken using a Leica DFC 495 digital camera mounted on a Leica Z16 Microscope with motorized z-stepping was used, and image stacks were merged using Leica Application Suite V 4.1.0 with Montage Module.

RESULTS

We compiled and mapped *Pheidole obscurithorax* specimen records from >170 sites (Fig. 4). We documented the earliest known records for nine geographic areas (South American countries and US states), including one for which we found no previously published records: Bolivia (Table 1).

Published South American site records of *P. obscurithorax* came from Argentina (Santschi 1923, Kempf 1972, Tillberg et al. 2006, LeBrun et al. 2007; Vittar 2008, Calcaterra et al. 2008, 2010; Dröse 2013), from Brazil (Rocha et al 2009; Santana 2011; 2012, Dattilo et al. 2012, Lopes et al. 2012, Rosado et al. 2012, Viani-Silva and Jacobi 2012, Boscardin et al. 2013, Dröse 2013, Pereira et al. 2013, Ulysséa and Brandão 2013; Melo et al. 2014), and from Paraguay (Wilson 2003, Wild 2007). Some authors were conservative and originally published South American records as *Pheidole* cf. *obscurithorax* (e.g., LeBrun et al. 2007, Calcaterra et al. 2008). But Calcaterra (pers. obs.) now considers the published records of *P*. cf. *obscurithorax* to be *P*. *obscurithorax*, and more recent papers use the latter name (e.g., Calcaterra et al. 2010). Unpublished records of *P. obscurithorax* came from Argentina (L.A. Calcaterra, pers. obs. and MCZ collection), from Bolivia (MCZ), from Brazil (antweb and MCZ), and from Paraguay (A. Wild).

Although Kusnezov (1953) wrote that *"Pheidole fallax arenicola var. obscurithorax*" was found in Argentina and in Alabama, he did not include this taxon on his own lists of ants known from Argentina *(*Kusnezov 1951, 1978). Instead, it appears that Kusnezov (1951, 1978) subsumed *obscurithorax* under the name *Pheidole fallax* Mayr, a species now thought to occur only in the circum-Caribbean region, with known South American records confined to Colombia and Venezuela (Wilson 2003). Kusnezov (1951) wrote that in Argentina, *P. fallax* was common, often dominant, and preferred open areas (a pattern matching that of *P. obscurithorax*). Kusnezov (1951) reported that *P. fallax* was the most common *Pheidole* species collected in northern Argentina, comprising 17% of all *Pheidole* records in the Miguel Lillo Foundation collection in Tucumán. It seems likely that many of these records of *P. fallax* in northern Argentina were actually *P. obscurithorax*. In fact, James Trager collected *P. obscurithorax* on the grounds of the Miguel Lillo Foundation (1983; MCZ collection).

Published North American records of *P. obscurithorax* came from Alabama (Naves 1985, Lockley 1996, Forster 2003, Storz and Tschinkel 2004, King and Tschinkel 2007), from Florida (Klotz et al 1995, Deyrup et al. 2000, Storz and Tschinkel 2004), from Georgia (King and Tschinkel 2007), from Mississippi (Storz and Tschinkel 2004, Hill 2006, King and Tschinkel 2007, MacGown and Hill 2010), and from Texas (King and Tschinkel 2007). Although Wilson (2003) reported that he first collected *P. obscurithorax* in Alabama in 1950, specimens he collected in the Smithsonian were dated 1949. Unpublished records of *P. obscurithorax* came from Alabama (J.A. MacGown pers. obs., MCZ), Florida (ABS, MCZ, School of Ants, A. Wild), and Mississippi (J.A. MacGown pers. obs., MCZ, bugguide.net).

DISCUSSION

True to Naves' (1985) speculation, the range of *Pheidole obscurithorax* in South America appears to be quite extensive, ranging 27.5 degrees of latitude, from 6.7°S to 34.2°S (Fig. 4). If *P. obscurithorax*

is so widespread in South America and often a dominant species, then it is clear that many South American *Pheidole* specimens previously identified in publications and in museums as other species, are probably *P. obscurithorax*. To more fully delineate the native range of *P. obscurithorax*, it would be valuable for researchers to re-examine South American *Pheidole* specimens, particularly specimens previously identified as *Pheidole fallax*. Despite Wilson's (2003) conclusion that *P. fallax* is limited to Caribbean area, with South American records limited to Colombia and Venezuela, numerous studies continue to record *P. fallax* from Argentina and Brazil (e.g., Ramos et al. 2004, Diehl et al. 2005, Martins et al. 2006, Delabie et al. 2007, Santos et al 2008, Vittar & Cuezzo 2008, Cuezzo and Campero 2009, Jaime 2010, Castro et al. 2012, Miranda et al. 2012, Ulysséa & Brandão 2013). While some of these records may be *P. jelskii*, others are probably *P. obscurithorax*.

Site records of *P. obscurithorax* from North America ranged only 3.5 degrees, from 28.0°N to 31.5°N. This may indicate that the North American populations of *P. obscurithorax* have a fairly narrow range of climatic tolerances. In South America, different *P. obscurithorax* populations may show physiological adaptations to the local climate. Thus, although the species as a whole is able to live under a great diversity of climatic conditions in South America, any one population may have a much narrower tolerance range. It is possible that the populations of *P. obscurithorax* now in North America are descended from colonists from a narrow geographic area and are not adapted to spread much beyond their current latitudinal range. In fact, Wild & Suarez (2009) conducted genetic analyses of native and exotic populations of *P. obscurithorax* and found that the North America populations appear to originate from a single introduction from a population most closely related to native study populations from a stretch along the Paraná River in northern Argentina from Resistencia (27.5°S) to Santa Fe (31.6°S). This latitudinal range is almost an exact match to the current latitudinal range of *P. obscurithorax* in North America. It is therefore possible that *P. obscurithorax* populations in North America will show little further latitudinal expansion.

Alternatively, the much greater latitudinal range of *P. obscurithorax* in South America could indicate that exotic populations of *P. obscurithorax* may show much additional expansion in North America and beyond. The range of *P. obscurithorax* in South America is similar to that of the fire ant *Solenopsis invicta* (Pitts 2002, Wetterer 2013). In North America, exotic populations of *P. obscurithorax* could potentially spread like those of *S. invicta*, across the southeastern US and into the West Indies (Wetterer 2013). Only time will tell.

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Table 1. Earliest known records of *Pheidole obscurithorax*. Unpublished records include collector, museum source, and site. MCZ = Museum of Comparative Zoology.

South America	Earliest record
Argentina	1920 (Santschi 1923)
Brazil	1952 (C. Gilbert, MCZ): Agudos
+Bolivia	1982 (J.C. Trager, MCZ): Club Las Palmas
Paraguay	1996 (Wild 2007)
North America	**Earliest record**
Alabama	1949 (E. O. Wilson, SI)**:** Bayfront
Florida	1992 (Deyrup et al. 2000)
Mississippi	1996 (T.C. Lockley, MCZ): I-10 Mile 1 marker
Georgia	2006 (King and Tschinkel 2007)
Texas	2006 (King and Tschinkel 2007)

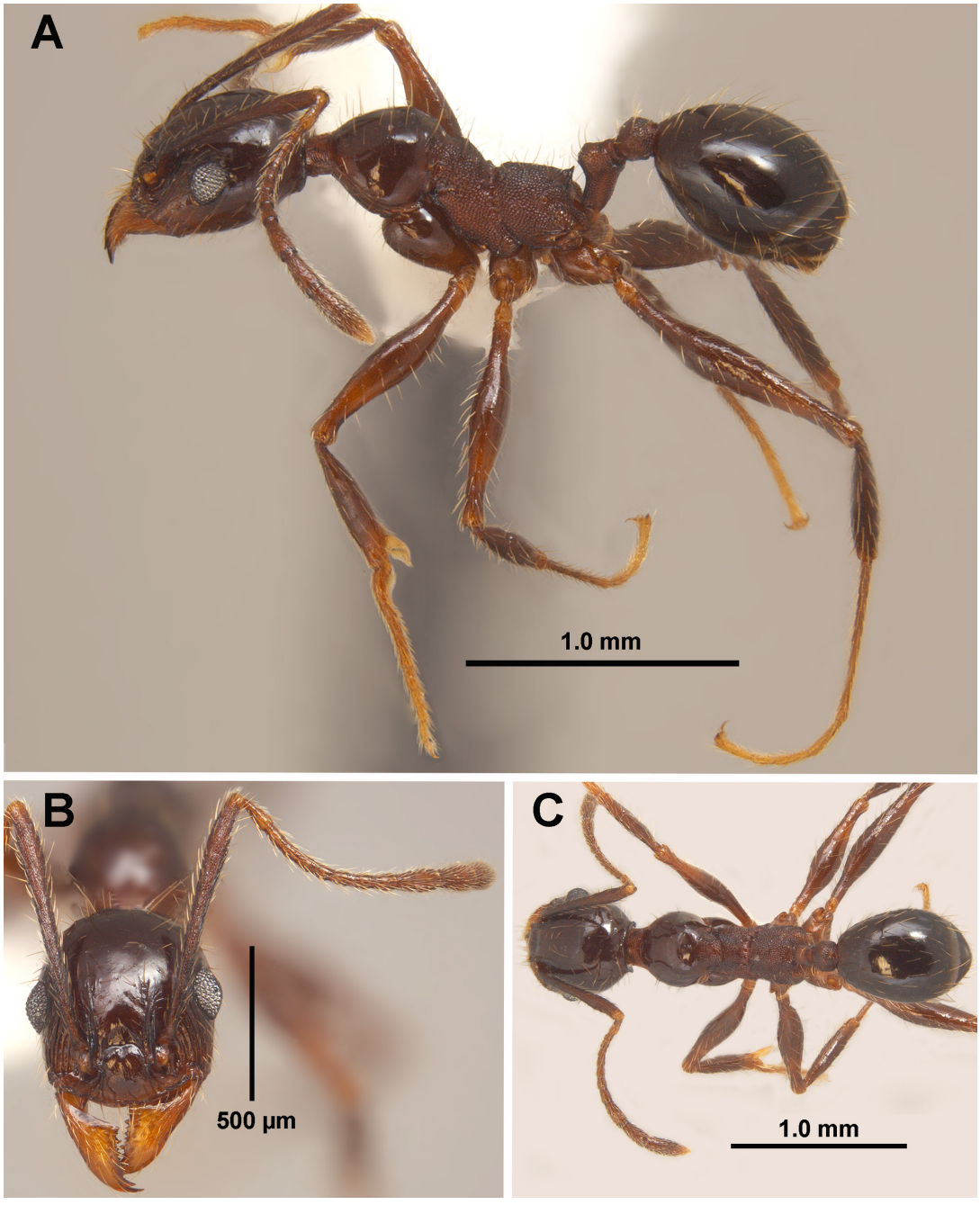

Figure. 1. *Pheidole obscurithorax*. a) lateral view, b) full face view and dorsal view of minor worker from Mobile, Alabama (photo by Joe A. MacGown).

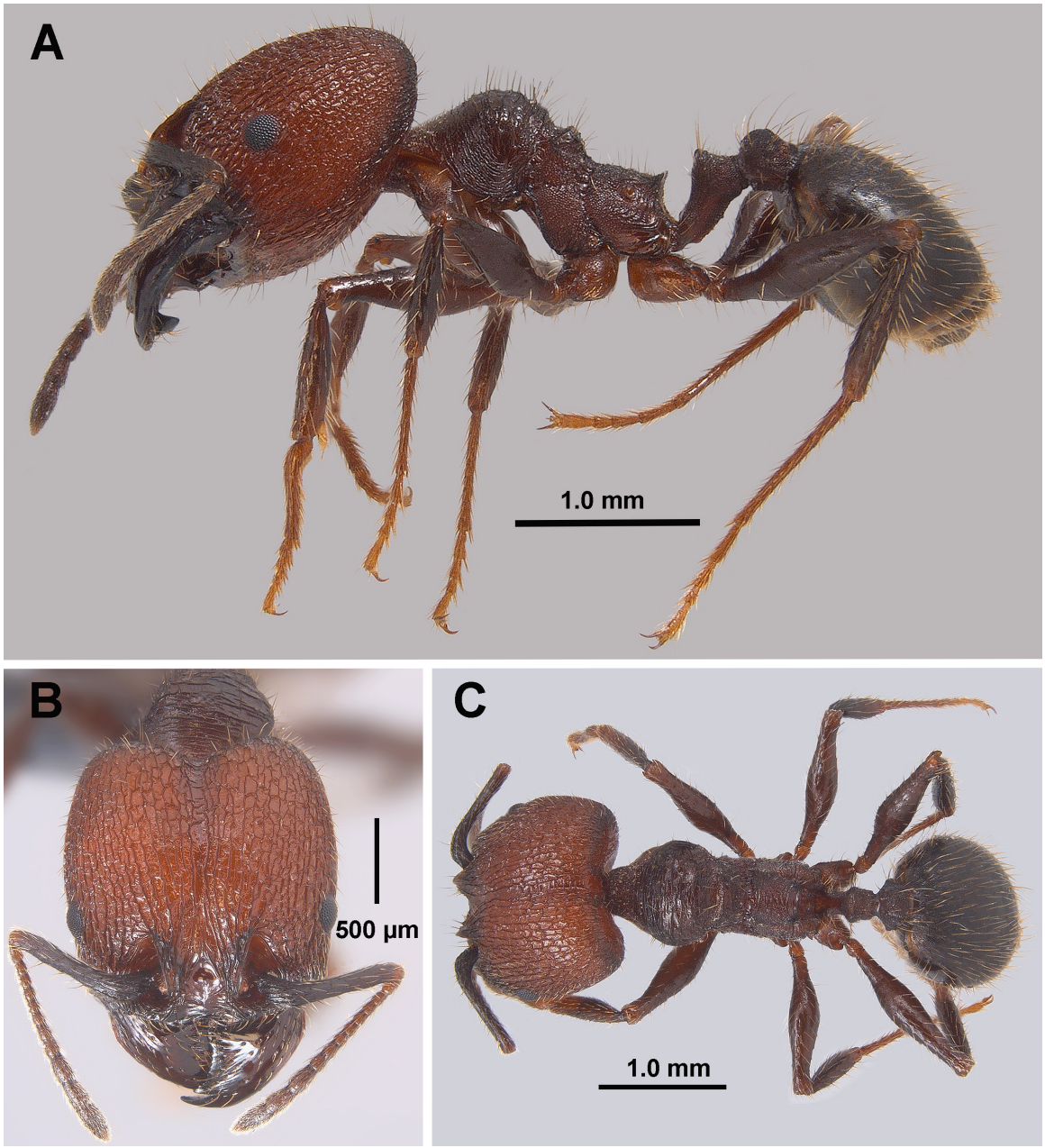

Figure 2. *Pheidole obscurithorax*. a) lateral view, b) full face view, and dorsal view of major worker from Mobile, Alabama (photo by Joe A. MacGown).

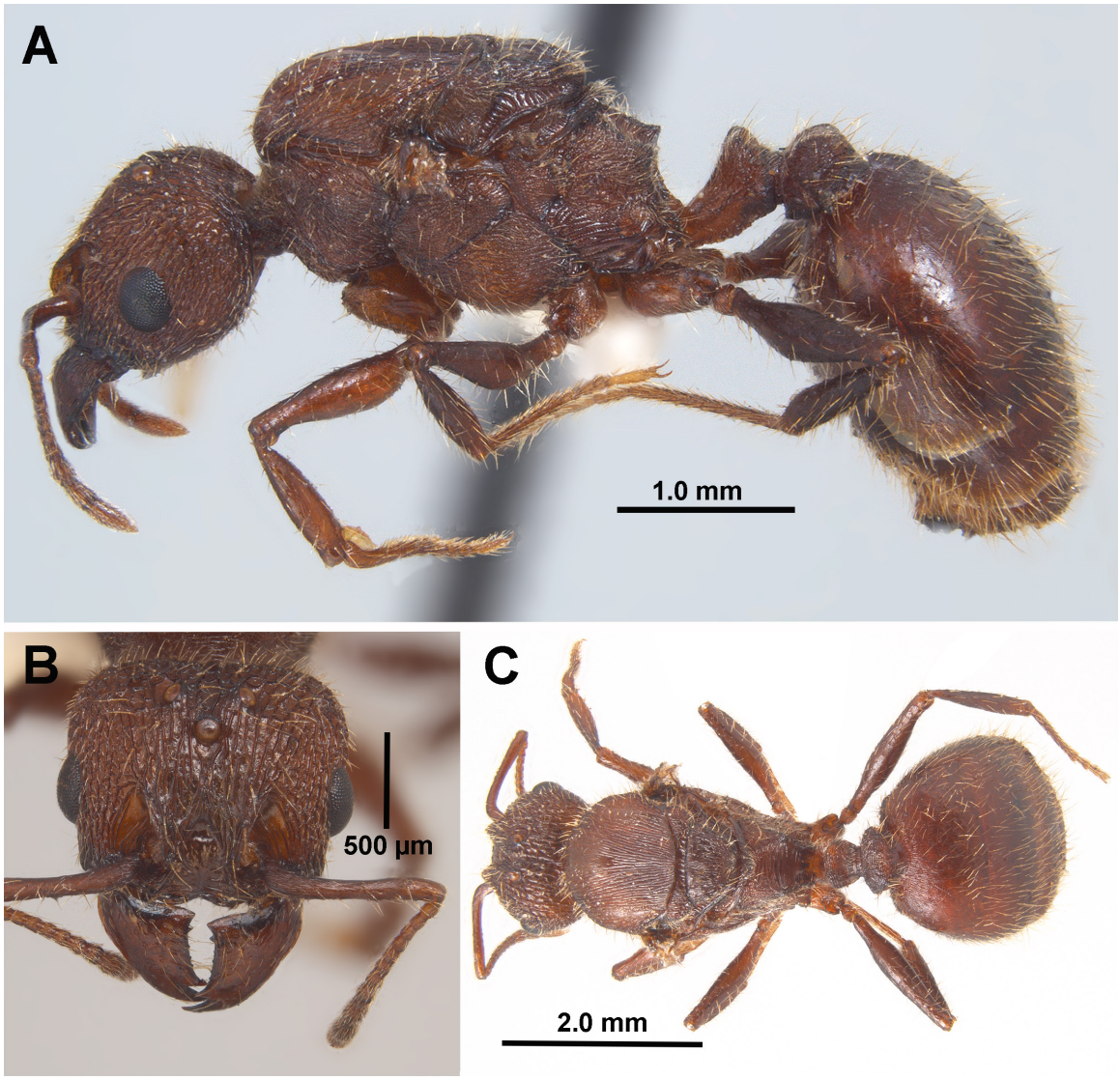

Figure 3. *Pheidole obscurithorax*. a) lateral view, b) full face view and dorsal view of a dealate queen from Mobile, Alabama (photo by Joe A. MacGown).

Figure 4. Geographic distribution of *Pheidole obscurithorax* records.