WORLDWIDE SPREAD OF *PHEIDOLE TENERIFFANA* (HYMENOPTERA: FORMICIDAE)

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ABSTRACT

Pheidole teneriffana is an Old World ant species that has spread to other parts of the world through human commerce. To evaluate its known distribution, I compiled and mapped *P. teneriffana* records from >200 sites. I documented the earliest known *P. teneriffana* records for 43 geographic areas (countries, island groups, major islands, and US states), including 11 West Indian islands for which I found no previously published records: Antigua, Barbados, Barbuda, Curaçao, Dominica, Dominican Republic (Hispañola), Guadeloupe, Jamaica, Martinique, Montserrat, and St Lucia. *Pheidole teneriffana* is known from sites scattered across the greater Mediterranean region (North Africa, southern Europe, the Middle East, and neighboring islands), though it is unclear which parts of this area constitute its native range. *Pheidole teneriffana* is known from only a few Old World sites distant from the Mediterranean region, i.e., Ascension, China, England, St Helena, and South Africa. In the New World, where this species is certainly exotic, there are published *P. teneriffana* records only from California, Cuba, and Peru. The first records from 11 West Indian islands presented here, all from 2003 or later, suggest that *P. teneriffana* is actively spreading through this region. Almost all West Indian records of *P. teneriffana* come from beaches or urban areas. It seems doubtful that *P. teneriffana* will develop into a major pest species like its congener, the infamous *Pheidole megacephala*.

Key words: biogeography, biological invasion, exotic species, invasive species

RESUMEN

Pheidole teneriffana es una especie de hormigas del Viejo Mundo que se ha extendido a otras partes del mundo a través del comercio humano. Para evaluar su distribución conocida, he compilado registros de *Pheidole teneriffana* de >200 sitios y los he puesto en un mapa. Documenté los registros de *P. teneriffana* mas antiguos conocidos de 43 zonas geográficas (países, grupos de islas, islas principales, y los estados de los EE.UU), incluyendo 11 islas de las Antillas de la cuales se encontró registros no estaban publicados anteriormente: Antigua, Barbados, Barbuda, Curazao, Dominica, República Dominicana (Hispañola), Guadalupe, Jamaica, Martinica, Montserrat y Santa Lucia. *Pheidole teneriffana* es conocida de sitios dispersos por toda la región Mediterránea (norte de África, el sur de Europa, el Medio Oriente y las islas vecinas), aunque no está claro qué partes de esta zona constituyen su área de distribución nativa. Se conoce la hormiga *Pheidole teneriffana* solamente de unos pocos lugares del Viejo Mundo lejos de la región Mediterránea, es decir, Ascensión, China, Inglaterra, Santa Elena y Sudáfrica. En el Nuevo Mundo, donde esta especie es ciertamente exótica, solo hay registros de *Pheidole teneriffana* publicados de California, Cuba y Perú. Los primeros registros de 11 islas de las Antillas que se presentan aqui, todos del año 2003 o después, indican que *P. teneriffana* esta dispersando activamente por esta región. Casi todos los registros de *P. teneriffana* de las Antillas provienen de las playas o zonas urbanas. Es ciertamente dudoso que *P. teneriffana* se convertirá en una importante especie plaga como su congénere, la infame *Pheidole megacephala.*

Numerous ant species have spread around the world through human commerce. For the most part, these "tramp" ants thrive only in disturbed environments and do not penetrate intact natural habitats. But as humans and their disturbance spread, so do tramp ants. The ecological importance of most tramp ants remains undocumented. Several species, however, such as *Pheidole megacephala* F., are known to have dramatic impacts (Wetterer 2007). For example, Zimmerman (1970) wrote that in Hawaii, "the endemic insect faunas of the lowlands of all the islands mostly have been exterminated throughout the range of the voracious introduced predatory ant *Pheidole megacephala*." In Australia, Young (2000) reported: "the rainforest at Howard Springs Nature Park is dominated by the coastal brown ant [*P. megacephala*], which has eliminated almost all species of native ants, other insect species, snails, spiders and centipedes."

In addition to *P. megacephala*, only one other Old World *Pheidole* species has spread to the New World: *Pheidole teneriffana* Forel, a species similar in size and general appearance as *P. mega-*

cephala. Here, I compiled and mapped of *P. teneriffana* specimen records to evaluate its known worldwide distribution and speculate on its native range and possible impact.

Forel (1893) described *P. teneriffana* from Tenerife in the Canary Islands, off the northwest coast of Africa. *Pheidole teneriffana* is the senior synonym of *P. teneriffana taina* described from Cuba. Taylor (2010) speculated on-line that *P. teneriffana* is a junior synonym of *P. fervens*, though this view has not been accepted by other researchers (S. Cover, pers. comm.). Like most *Pheidole* species, *P. teneriffana* shows complete dimorphism (i.e., distinct minor and major workers with few, if any, intermediates) with majors having disproportionately large heads compared to minors. It is fairly simple to distinguish *P. teneriffana* from *P. megacephala.* In *P. teneriffana* majors, sculpturing covers the entire dorsal surface of the head, but in *P. megacephala,* sculpturing is confined to the anterior half of the head, (S. Cover, pers. comm.).

Materials and Methods

Using published and unpublished records, I documented the worldwide range of *Pheidole teneriffana.* I obtained unpublished site records from museum specimens in the collection of the Museum of Comparative Zoology (MCZ) and the Smithsonian Institution (SI). In addition, I used on-line databases with collection information on specimens by Antweb (www.antweb.org), Asociación Ibérica de Mirmecología (www.formicidae.org), the Global Biodiversity Information Facility (www.gbif.org), and Ants of Africa (Taylor 2010). Finally, I collected *P. teneriffana* specimens on islands of the West Indies.

I obtained geo-coordinates for collection sites from published references, specimen labels, maps, or geography web sites (e.g., earth.google.com, www.tageo.com, and www.fallingrain.com). If a site record listed a geographic region rather than a "point locale," and I had no other record for this region, I 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. I did not map records of *P. teneriffana* found in newly imported goods or intercepted in transit by quarantine inspectors, e.g., a specimen intercepted in South Africa on goods from Kenya (G. Arnold; SI).

Results

I collected *Pheidole teneriffana* at 20 sites on 10 West Indian islands: Antigua: St John's, city street (May 2007); Barbados: Bridgetown, city street (Jun 2006) and Oistins Beach (Nov 2003); Barbuda: Codrington, town (Jul 2007); Curaçao: Otrobanda, city street (Aug 2011), Punda, city street (Jul 2004), and Punda, market (Aug 2011); Dominica: Roseau, urban waterfront (Jun 2004); Guadeloupe: Bas du Fort, shopping center (May 2008), Pointe-à-Pitre, by downtown store (Jun 2011), Sainte Anne, town center (May 2008), and Vieux Habitants, town (Jun 2008); Jamaica: Montego Bay, urban produce market (Dec 2010); Martinique: Fort-de-France, urban park (May 2008), Fort-de-France, city street (May 2008), and Robert, urban waterfront (Jul 2011); Montserrat: Old Road Bay, waterfront by an abandoned hotel (Jul 2007); St Lucia: Dennery, waterfront (Jul 2006), Micoud, waterfront (Jul 2006), and Pigeon Island, beach (Nov 2003). In addition, I obtained unpublished records from two other West Indian sites: Dominican Republic: Navarrette at bakery (Dec 2003; S. Cover) and St Lucia: Soufriere (Jan 2005; J. Endeman). I deposited voucher specimens from all sites at the MCZ.

I compiled *Pheidole teneriffana* specimen records from >200 sites worldwide (Fig. 1). I documented the earliest known *P. teneriffana* records for 43 geographic areas (countries, island groups, major islands, and US states; Tables 1-3) including 11 West Indian islands for which I found no previously published records: Antigua, Barbados, Barbuda, Curaçao, Dominica, Dominican Republic (Hispañola), Guadeloupe, Jamaica, Martinique, Montserrat, and St Lucia.

Santschi (1919) listed *Pheidole teneriffana* (identified by G. Arnold), but not *P. megacephala*, from Samoa. Santschi (1928), however, listed *P. megacephala* from Samoa, but not *P. teneriffana*, indicating that he dismissed the earlier identification. Almost half of all mapped site records I found for *P. teneriffana* came from Egypt (e.g., Santschi 1908, Forel 1913, Alfieri 1931). Although Taylor (2010) regarded the records of *P. teneriffana* from Egypt to be *Pheidole providens*, a species otherwise known only from India, I mapped these as *P. teneriffana* nonetheless.

Discussion

Pheidole teneriffana has widely scattered records from across the greater Mediterranean region (North Africa, Southern Europe, the Middle East, and neighboring islands), though it is unclear which parts of this region, if any, constitute its native range. Santschi (1918) proposed that *P. teneriffana* probably originated in upper Nile area, in what is now South Sudan, but there are no *P. teneriffana* specimens known from this region. Wilson (2003) wrote that *P. teneriffana* "is evidently a native of North Africa and possibly also the Canary Islands." Emery (1915) and Espadaler & Bernal (2003) considered *P. teneriffana* as exotic in the Canary Islands. Bytinski-Salz (1953) considered *P. teneriffana* as a recently arrived exotic in Israel, writing, "*Pheidole teneriff-*

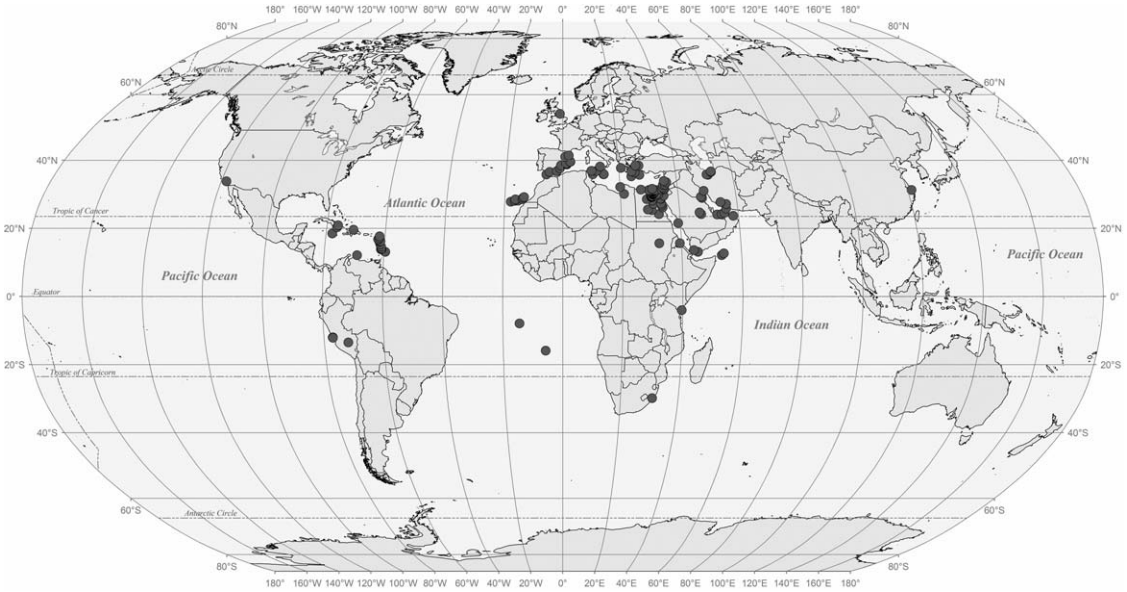

Fig. 1. Worldwide distribution records of *Pheidole teneriffana*. All New World records are previously unpublished, except those from California, Cuba, and Peru.

fana, so far found east only till Egypt, reached Tel Aviv a few years ago." Collingwood et al. (2004) wrote that *P. teneriffana* "is probably native throughout northern Africa and appears to be spreading over a wide front in the Middle East, Arabia and the Mediterranean countries." If *P. teneriffana* is truly native across North Africa, it is remarkable how few records I found from any North African country other than Egypt: Western Sahara (0 records), Morocco (1 record), Algeria (0

TABLE 1. EARLIEST KNOWN RECORDS FOR *PHEIDOLE TENERIFFANA* FROM THE GREATER MEDITERRANEAN REGION: NORTH AFRICA, THE MIDDLE EAST, SOUTHERN EUROPE, AND NEIGHBORING ISLANDS.

	Earliest record
Canary Islands	1893 (Forel 1893)
Eritrea	≤1901 (Emery 1901)
Egypt	≤1908 (Santschi 1908)
Tunisia	1908 (Santschi 1908)
Turkey	≤1911 (Forel 1911)
Sudan	≤1918 (Santschi 1918)
Libya	≤1924 (Emery 1924)
Greece	1932 (Zimmermann 1934)
Syria	≤1934 (Menozzi 1934)
Israel	≤1949 (Bytinski-Salz 1953)
Saudi Arabia	1950 (Collingwood 1985)
Malta	1965 (Baroni Urbani 1968)
Spain	1981 (Acosta & Martínez 1983)
Balearic Islands	1985 (de Haro et al. 1986)
Lebanon	≤1987 (Kugler 1988)
Italy	1987 (Mei 1995)
Sicily	1990 (Mei 1995)
UAE	1991 (Collingwood et al. 1997)
Morocco	1992 (Delabie 2007)
Yemen	1993 (Collingwood & Agosti 1996)
Iran	≤1995 (Alipanah et al. 1995 in Paknia et al. 2008)
Oman	≤1996 (Collingwood & Agosti 1996)
Kuwait	≤1996 (Collingwood & Agosti 1996)

TABLE 2. EARLIEST KNOWN RECORDS FOR *PHEIDOLE TENERIFFANA* FROM SUB-SAHARAN AFRICA, EAST ASIA, NORTH EUROPE, AND SOUTH ATLANTIC ISLANDS.

	Earliest record
Kenya	≤1918 (Santschi 1918)
South Africa	≤1925 (Santschi 1925)
China	≤1925 (Santschi 1925)
England	≤1987 (Collingwood 1987)
St Helena	2002 (Wetterer et al. 2007)
Ascension	2002 (Wetterer et al. 2007)

records), Tunisia (2 records), Libya (1 record), and Sudan (1 record).

The earliest records of *P. teneriffana* come from the Canary Islands in the far west of the greater Mediterranean region and from Eritrea in the far southeast, followed by records from Egypt, Tunisia, and Turkey in between (Table 1). This chronology of the earliest known records does not favor any particular hypothesis concerning what part of the greater Mediterranean region may be the original native range of *P. teneriffana*. Suppositions on where *P. teneriffana* originated have been based on very little evidence. Genetic analyses may be necessary to evaluate the native range of this species. It seems unlikely that *P. teneriffana* is native to any of the isolated Old World sites where it has been collected distant from the Mediterranean region, i.e., Ascension, China, England, St Helena, and South Africa.

In the New World, where this species is certainly exotic, I found published *P. teneriffana* records only from California, Cuba, and Peru (Wilson 2003). The records presented here of *P. teneriffana* from 11 West Indian islands, all from 2003 or later, suggest that *P. teneriffana* is actively spreading through this region. In the West Indies, I found *P. teneriffana* almost exclusively on beaches and at highly disturbed urban sites, particularly in waterfront areas. Santschi (1934), reporting this species from Alexandria, Egypt, similarly noted that *P. teneriffana* was rarely reported far from seaports. Both in Montego Bay, Jamaica and Pointe-à-Pitre, Guadeloupe, I found *P. teneriffana* nesting in the cracked concrete at the base of a doorway of a market. In Montego Bay, I found no other ants in the nearby dusty urban street, while in Pointe-à-Pitre, I found *P. megacephala* nesting at the bases of all the neighboring trees along the sidewalk outside the store. It may be that *P. teneriffana* is able to nest in microhabitats too dry for other species. Curiously, most Old World records of *P. teneriffana* are subtropical, but all New World records are tropical, except one from California (Fig. 1), and this one population appears to have been extirpated by another exotic ant, *Linepithema humile* (Gulmahamad 1999).

Pheidole teneriffana has remained relatively inconspicuous throughout most of its range, though it may become common in some urban areas. Collingwood et al. (1997) reported that in the United Arab Emirates, *P. teneriffana* was "very populous in irrigated gardens and along the coast where it appears to be spreading rapidly, and might replace local species." In the Balearic Islands, Gómez & Espadaler (2006) reported that in Ibiza city, Ibiza, *P. teneriffana* "has become a common species in the gardens and trees and on sidewalks near the harbour. It seems to be expanding its range in Mallorca from El Arenal gardens - where it may become very abundant—to Son Verí to the East and La Lonja (Palma city) in the West,

TABLE 3. EARLIEST KNOWN RECORDS FOR *PHEIDOLE TENERIFFANA* FROM THE NEW WORLD. UNPUBLISHED RECORDS INCLUDE COLLECTOR, MUSEUM SOURCE, AND SITE.

	Earliest record
Cuba	1930 (Aguayo 1932 as *P. teneriffana taina*)
Peru	1967 (R. H. Crozier, MCZ): Ciudad Univ. San Marcos
California	1989 (Martinez 1992)
+St Lucia	2003 (J. K. Wetterer, MCZ): Pigeon Island
+Barbados	2003 (J. K. Wetterer, MCZ): Oistins
+Dominican Rep.	2003 (S. P. Cover, MCZ): Navarrette
+Dominica	2004 (J. K. Wetterer, MCZ): Roseau
+Curaçao	2004 (J. K. Wetterer, MCZ): Punda
+Antigua	2007 (J. K. Wetterer, MCZ): St John's
+Barbuda	2007 (J. K. Wetterer, MCZ): Codrington
+Montserrat	2007 (J. K. Wetterer, MCZ): Old Road Bay
+Martinique	2008 (J. K. Wetterer, MCZ): Fort-de-France
+Guadeloupe	2008 (J. K. Wetterer, MCZ): Sainte Anne
+Jamaica	2010 (J. K. Wetterer, MCZ): Montego Bay

MCZ = Museum of Comparative Zoology. + = No previously published records.

always in disturbed habitats." Nonetheless, it seems unlikely that *P. teneriffana* will develop into a major pest species like *P. megacephala*. Future studies might examine why *P. teneriffana* and *P. megacephala,* two species that are morphologically very similar, have such different ecological impacts.

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