

## Worldwide spread of the difficult white-footed ant, *Technomyrmex difficilis* (Hymenoptera: Formicidae)

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### Abstract

*Technomyrmex difficilis* FOREL, 1892 is apparently native to Madagascar, but began spreading through Southeast Asia and Oceania more than 60 years ago. In 1986, *T. difficilis* was first found in the New World, but until 2007 it was misidentified as *Technomyrmex albipes* (SMITH, 1861). Here, I examine the worldwide spread of *T. difficilis*.

I compiled *Technomyrmex difficilis* specimen records from > 200 sites, documenting the earliest known *T. difficilis* records for 33 geographic areas (countries, island groups, major islands, and US states), including several for which I found no previously published records: the Bahamas, Honduras, Jamaica, the Mascarene Islands, Missouri, Oklahoma, South Africa, and Washington DC.

Almost all outdoor records of *Technomyrmex difficilis* are from tropical areas, extending into the subtropics only in Madagascar, South Africa, the southeastern US, and the Bahamas. In addition, there are several indoor records of *T. difficilis* from greenhouses at zoos and botanical gardens in temperate parts of the US. Over the past few years, *T. difficilis* has become a dominant arboreal ant at numerous sites in Florida and the West Indies. Unfortunately, *T. difficilis* appears to be able to invade intact forest habitats, where it can more readily impact native species. It is likely that in the coming years, *T. difficilis* will become increasingly more important as a pest in Florida and the West Indies.

**Key words:** Biogeography, biological invasion, exotic species, invasive species.

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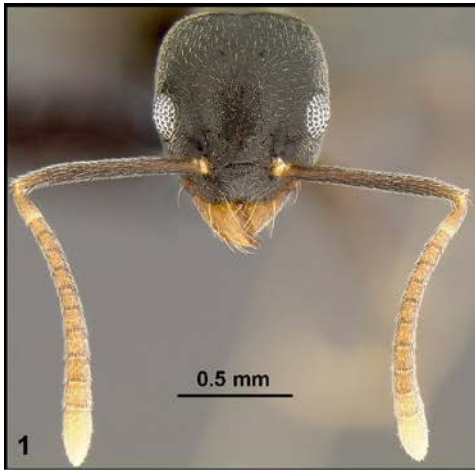
### Introduction

FOREL (1911) listed 15 tramp ant species, spread by human commerce, which had achieved or were in the process of achieving cosmopolitan distributions. Eight of these have become major ecological, agricultural, and / or household pests: *Anoplolepis gracilipes* (SMITH, 1857), *Linepithema humile* (MAYR, 1868), *Monomorium destructor* (JERDON, 1851), *Monomorium pharaonis* (LINNAEUS, 1758), *Paratrechina longicornis* (LATREILLE, 1802), *Pheidole megacephala* (FABRICIUS, 1793), *Solenopsis geminata* (FABRICIUS, 1804), and *Tapinoma melanocephalum* (FABRICIUS, 1793) (e.g., see WETTERER 2005, 2007, 2008a, 2009a, b, WETTERER & al. 2009, WETTERER 2011, 2012). In the 20<sup>th</sup> century, several ant species not on FOREL's (1911) list have become cosmopolitan pests, notably *Solenopsis invicta* BUREN, 1972 and *Wasmannia auropunctata* (ROGER, 1863) (BUREN & al. 1974, WETTERER & PORTER 2003). One emerging cosmopolitan pest ant species, now spreading rapidly through Florida and the West Indies, is *Technomyrmex difficilis* FOREL, 1892 (Figs. 1 - 4).

Before BOLTON's (2007) comprehensive revision of the genus *Technomyrmex*, specimens of *T. difficilis* and several other *Technomyrmex* species were usually misidentified in the scientific literature and popular press as the white-footed ant, *Technomyrmex albipes* (SMITH, 1861). BOLTON

(2007) wrote: "In the past many samples of small, darkly coloured *Technomyrmex* in which the gaster is setose and the tarsi are white or yellow have been misidentified as *T. albipes*, but in particular *albipes* has been confused with *vitiensis*, *difficilis*, *pallipes*, *brunneus*, *jocosus* and *moerens*." When Barry Bolton was preparing his 2007 revision, I sent him what I thought were *T. albipes* specimens I had collected in my past studies. I was shocked to find out that I had never actually collected genuine *T. albipes*. My "*T. albipes*" specimens from Hawaii (WETTERER 1997) were *Technomyrmex vitiensis* MANN, 1921, my "*T. albipes*" specimens from Madeira (WETTERER & al. 2006) were *Technomyrmex pallipes* (SMITH, 1876), and my "*T. albipes*" specimens from Florida (e.g., WETTERER & WETTERER 2003, WETTERER & al. 2007) were *T. difficilis*. In fact, all *Technomyrmex* specimens from Florida and the West Indies that BOLTON (2007) and WETTERER (2008b) re-examined were *T. difficilis*. WETTERER (2008b) reviewed the spread of *T. difficilis* in the southeastern US and the West Indies. Here, I examine the spread of *T. difficilis* in the rest of the world as well.

Of the many hundreds of published reports of "*Technomyrmex albipes*" from the Old World, a significant but unknown proportion were based on misidentifications. Unfortunately, it is not possible to determine the actual species



Figs. 1 - 4: *Technomyrmex difficilis*. (1 - 3) Worker from 10 km NW Lockhart River, Australia (CASENT 0171131), (1) head, (2) lateral view, (3) dorsal view (photos by E.M. Sarnat, www.antweb.org). (4) Worker tending a mealybug, Cape Tribulation, Australia (photo by A.L. Wild).

identity of most published "*T. albipes*" records from the Old World without examining the specimens. BOLTON (2007) believed that all recently published records of *T. albipes* from Australia were probably misidentified *T. difficilis*, as were at least some published records from Pacific islands in WILSON & TAYLOR (1967). But, as BOLTON (2007) pointed out, in the absence of specimens, the actual identity of a great many published *T. albipes* records "must remain equivocal".

#### Taxonomy and identification

FOREL (1892) described *Technomyrmex mayri difficilis* (= *T. difficilis*) from Madagascar, writing (in French) that it was "difficult to define", with many characters intermediate between those of *Technomyrmex mayri* FOREL, 1891 (known only from Madagascar) and the widespread *T. albipes*. FOREL (1892) wrote: "I do not know how otherwise to define this embarrassing form, which is perhaps a hybrid." Fortunately, most *T. difficilis* specimens turn out to be quite simple to identify with certainty. BOLTON (2007) wrote that for *T. difficilis*, "the presence in that species of a pair of setae on the dorsal head behind the level of the posterior margin of the eye easily distinguishes them. However, workers of *difficilis* in which the head is abraded are difficult

to distinguish from *albipes*". Although these diagnostic setae are often difficult to discern in face-on views (Fig. 1), they are easily viewed in silhouette (Figs. 2, 3). I am personally very thankful for these two little hairs.

I use "difficult white-footed ant" as a common name for *Technomyrmex difficilis*, based on the Latin *difficilis* combined with the common name used until recently for several tramp *Technomyrmex* species. This common name is unlikely to be confused with any other. The name fits well with the reputation this ant has acquired in Florida. For example, WARNER & al. (2005) wrote that *T. difficilis* "is an extremely difficult pest to control due to the large size of its colonies". Use of the simpler common name "white-footed ant" for *T. difficilis* seems inadvisable because this name could be equally applied to many other *Technomyrmex* species, e.g., *T. vitiensis*, and it seems most appropriate for use with *T. albipes* (*albipes* = "white-footed" in Latin). Although many researchers dislike common names for insects, people working in pest control generally use common names to identify pest species and *T. difficilis* is developing into a serious pest. Using a unique common name for *T. difficilis*, the difficult white-footed ant, emphasizes the fact that this newly recognized pest is distinct from *T. albipes*.

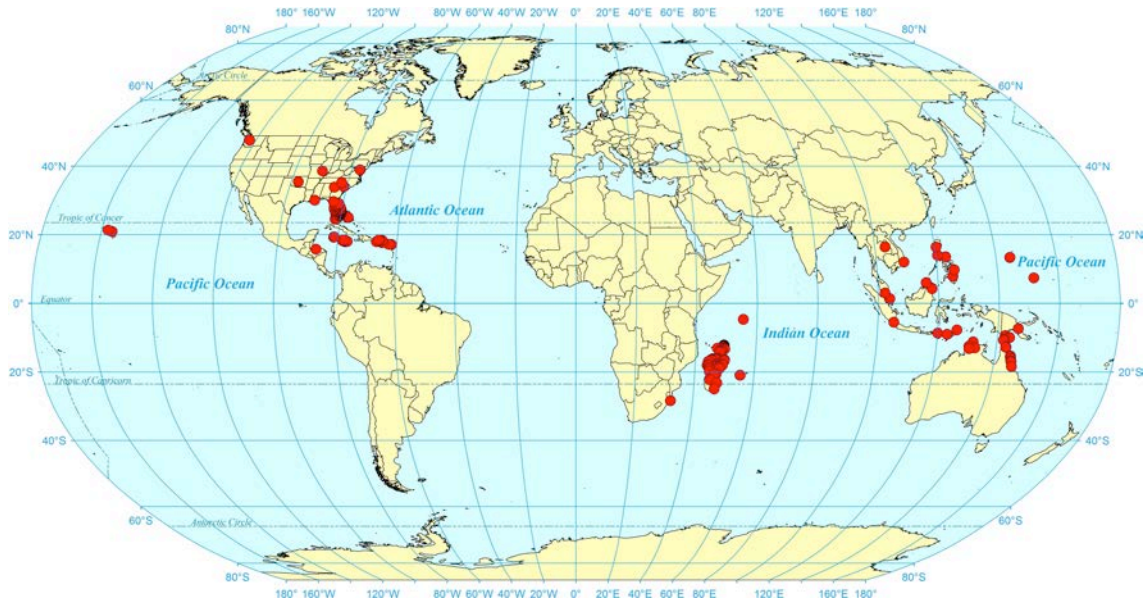


Fig. 5: Worldwide distribution records of *Technomyrmex difficilis*.

Tab. 1: Earliest known records of *Technomyrmex difficilis* from areas of the Old World. Unpublished records include collector, source, and site. + = no previously published records. CAS = California Academy of Sciences. ANIC = Australian National Insect Collection.

Africa & adjacent islands	Earliest record
Madagascar	≤ 1892 (FOREL 1892)
Seychelles	≤ 1909 (FOREL 1909)
+ Mascarene Islands	2007 (B.L. Fisher & al., CAS): Grande Chaloupe, Réunion
+ South Africa	2008 (A.L. Wild, pers. comm.): St. Lucia, KwaZulu-Natal
Asia & Oceania	
Mariana Islands	1946 (N.L.H. Krauss, ANIC): Mt. Alifan, Guam
Singapore	≤ 1948 (BOLTON 2007)
FS Micronesia	1953 (J.L. Gressitt, ANIC): Mt Iron, Fefan Island
Australia	1972 (R.W Taylor & J.E. Feehan, ANIC): Sawcut Gorge
Philippines	1985 (BOLTON 2007)
Malaysia	1991 (DELABIE & al. 2011)
Hawaii	1994 (STARR & STARR 2012)
Thailand	1997 (BOLTON 2007)
Timor Leste	2003 - 2006 (TRAINOR & ANDERSEN 2010)
Indonesia	≤ 2007 (BOLTON 2007)
Papua New Guinea	≤ 2007 (BOLTON 2007)
Vietnam	≤ 2007 (BOLTON 2007)

## Materials and methods

I compiled and mapped published records of *Technomyrmex difficilis* from the literature. I obtained unpublished site records from museum specimens in the collections of the Museum of Comparative Zoology (MCZ) and the Smithsonian Institution (SI). I positively identified *T. difficilis* specimens based on the presence of setae on the head as mentioned above. I did not attempt further identification of *Technomyrmex* specimens lacking these setae. In addition, I used on-line databases with collection information on specimens by AntWeb ([www.antweb.org](http://www.antweb.org)), the Global Biodiversity Information Facility ([www.gbif.org](http://www.gbif.org)), the Australian National Insect Collection database, and [antbase.net](http://antbase.net). I included records from both outdoor and indoor populations, but I did not include records of *T. difficilis* intercepted in transit.

Geographic coordinates for collection sites came from published references, specimen labels, maps, or geography web sites (e.g., [earth.google.com](http://earth.google.com), [www.tageo.com](http://www.tageo.com), and [www.fallingrain.com](http://www.fallingrain.com)). For older references and specimens, many site names, particularly in Arabia, are no longer in use or are now spelled differently and I searched, not always successfully, to determine current names. 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.

## Results

I compiled *Technomyrmex difficilis* specimen records from > 200 sites worldwide (Fig. 5). I documented the earliest known *T. difficilis* records for 33 geographic areas (countries, island groups, major Caribbean islands, and US states; Tabs. 1 - 2), including some locales for which I found no previously published records: Bahamas, Honduras, Jamaica, Mascarene Islands, Missouri, Oklahoma, South Africa, and Washington DC. Almost all outdoor records of *T. difficilis* are from tropical areas, extending into the subtropics

Tab. 2: Earliest known records of *Technomyrmex difficilis* from areas of the New World. Unpublished records include collector, source, and site. + = no previously published records. MCZ = Museum of Comparative Zoology.

North America	Earliest record
Florida	1986 (DEYRUP 1991 as <i>T. albipes</i> )
+ Missouri	~ 2000 (J.C. Trager, pers. comm.): Missouri Botanical Garden
Washington	2002 (J.T. Longino, www.antweb.org): Woodland Park Zoo
South Carolina	2003 (T.S. Davis, MCZ): Riverbanks Zoo
Georgia	2004 (WARNER & SCHEFFRAHN 2004 as <i>T. albipes</i> )
Louisiana	2004 (WARNER & SCHEFFRAHN 2004 as <i>T. albipes</i> )
North Carolina	2004 (WARNER & SCHEFFRAHN 2005 as <i>T. albipes</i> )
+ Oklahoma	2006 (A. Storjohann, MCZ): Myriad Botanical Gardens
+ Washington DC	2010 (J.K. Wetterer, MCZ): National Zoo
+ Bahamas	2010 (J.K. Wetterer, MCZ): Coral Harbour, New Providence
Neotropics	
Puerto Rico	1996 (TORRES & al. 2001 as <i>Technomyrmex</i> sp.)
Grand Cayman	2003 (WARNER & SCHEFFRAHN 2004 as <i>T. albipes</i> )
St Croix	2005 (WETTERER 2008b)
St Thomas	2005 (WETTERER 2008b)
Antigua	2007 (WETTERER 2008b)
Nevis	2007 (WETTERER 2008b)
+ Honduras	2007 (P.S. Ward, www.antweb.org): 4 km WSW of La Ceiba
+ Jamaica	2010 (J.K. Wetterer, MCZ): Montego Bay

in Madagascar, South Africa, the Southeast US, and the Bahamas (Fig. 5).

Rick Grantham sent me *Technomyrmex difficilis* specimens that Allan Storjohann collected inside a greenhouse at the Myriad Botanical Gardens in Oklahoma City, which he believed probably came from Florida on a shipment of orchids several years earlier (GRANTHAM 2007).

Although all *Technomyrmex* specimens from Florida and the West Indies that BOLTON (2007) and I have examined are *T. difficilis*, it would be useful to evaluate all available *Technomyrmex* specimens from this region to confirm their species identity. It would be unfortunate if the incorrect assumption that all *Technomyrmex* in Florida are *T. albipes* were replaced with another incorrect assumption, that they are all *T. difficilis*.

CLARKE & al. (2008) listed *T. difficilis* from the San Francisco Bay area, citing the AntWeb list of ants from

this area, but the AntWeb website has subsequently changed the identification to *Technomyrmex vitiensis*.

## Discussion

*Technomyrmex difficilis* is apparently native to Madagascar, where it occurs in a variety of intact and disturbed habitats. It spread through human commerce to Southeast Asia and Oceania more than 60 years ago and more recently to the New World (Tabs. 1 - 2). It is striking that *T. difficilis* is so commonly found in Madagascar, and has successfully spread to many distant parts of the world, yet only a single record of this species has been recorded from nearby continental Africa (Fig. 5). This may be due to an actual absence or to poor sampling. It seems more likely, however, that many "*T. albipes*" records from continental Africa (and other parts of the world) are actually *T. difficilis*.

The earliest specimens of *Technomyrmex difficilis* (misidentified as *T. albipes*) from the New World were collected in Florida in 1986 (DEYRUP 1991). Since then, *T. difficilis* has quickly expanded its range across a large portion of the state (DEYRUP & al. 2000, WARNER & SCHEFFRAHN 2004, 2005). WARNER & SCHEFFRAHN (2004, 2005) also noted the occurrence of "*T. albipes*" (which I assume were actually *T. difficilis*) in Georgia, Louisiana, North Carolina, and South Carolina (Tab. 2). In addition, there are several records of *T. difficilis* from greenhouses at zoos and botanical gardens in temperate parts of the US (Tab. 2).

*Technomyrmex difficilis* is quickly becoming established across the West Indies. TORRES & al. (2001) reported the earliest record of *Technomyrmex* (presumably *T. difficilis*) from the West Indies, males collected in 1996 and 1997 in Guánica, Puerto Rico. WARNER & SCHEFFRAHN (2004) reported *Technomyrmex* collected in 2003 on Grand Cayman Island. In 2005 - 2007, WETTERER (2008b) collected *T. difficilis* on five West Indian islands (Antigua, Nevis, Puerto Rico, St. Croix, and St. Thomas), finding widespread populations on St. Croix. DEYRUP (1998) surveyed New Providence, Bahamas in 1995 and did not find *T. difficilis*, but in 2010, I found *T. difficilis* was common at nine sites on New Providence. It appears that the spread of this ant on New Providence may be quite recent and rapid. Also in 2010, I found *T. difficilis* for the first time on Jamaica, at 11 sites across the island, where this ant is clearly well established.

*Technomyrmex difficilis* appears to be the most widespread member of its genus, but *T. vitiensis*, originally from the Indo-Pacific, also seems to be emerging as a cosmopolitan tramp species with recent exotic records from around the world, including European greenhouses, Hawaii, California, and French Guiana (BOLTON 2007, DELABIE & al. 2011). The French Guinea record comes from an intact forest area, suggesting that this species is able to invade forest habitats.

In Florida and the West Indies, *Technomyrmex difficilis* is quickly becoming a dominant pest in disturbed urban and residential areas. For example, over the past few years, *T. difficilis* has become a dominant arboreal ant on the Florida Atlantic University (FAU) campus in Jupiter, Florida. A large proportion of the pine trees on campus have *T. difficilis* nesting under the bark. At local beaches in Palm Beach County, Florida, mangroves and sea grape trees are often overrun with *T. difficilis*. I have even experienced outbreaks of this ant in my office in Jupiter, Florida and

at my home in Stuart, Florida. Trails of these ants stream along the outside walls of my house and, until being controlled using boric acid, poured out of electric sockets in my kitchen and upstairs bathroom. My parents' backyard pool area in Palm Beach Gardens, Florida once overrun by *Nylanderia pubens* (FOREL, 1893), is now dominated by *T. difficilis*, which tend Hemiptera on their citrus trees. Unfortunately, *T. difficilis* also can invade forest habitats, where it can more readily impact native species. It is likely that over the next few years, *T. difficilis* will become increasingly important as an economic and ecological pest in Florida and the West Indies.

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