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Worldwide spread of the destroyer ant, *Monomorium destructor* (Hymenoptera: Formicidae)

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Abstract

The destroyer ant, *Monomorium destructor* (JERDON, 1851), is a pest in many tropical and subtropical areas, where it is notorious for chewing through the insulation of electrical wires, living in and destroying electrical equipment, and attacking people. To evaluate the spread of *M. destructor*, I compiled published and unpublished specimen records from > 600 sites worldwide. I documented the earliest known *M. destructor* records for 107 geographic areas (countries, island groups, major Caribbean islands, and US states), including many locales for which I found no previously published records: Bahamas, Barbados, Barbuda, Bonaire, Comoro Islands, Curaçao, Grenada, Haiti, Honduras, Kenya, Nevis, Pakistan, Réunion, St. Lucia, St. Martin, St. Vincent, Tobago, and Venezuela. *Monomorium destructor* most closely resembles several African *Monomorium* species, and has a seemingly continuous distribution from North Africa to Southeast Asia, suggesting *M. destructor* originated in North Africa, but is also native to the Middle East and South Asia. *Monomorium destructor* is most common as a pest in disturbed arid and semi-arid habitats in the tropics and subtropics. Outbreaks of *M. destructor* often appear to be fairly localized and short-lived. This pattern of population explosion followed by decline should be taken into consideration in any large-scale efforts to control these ants.

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

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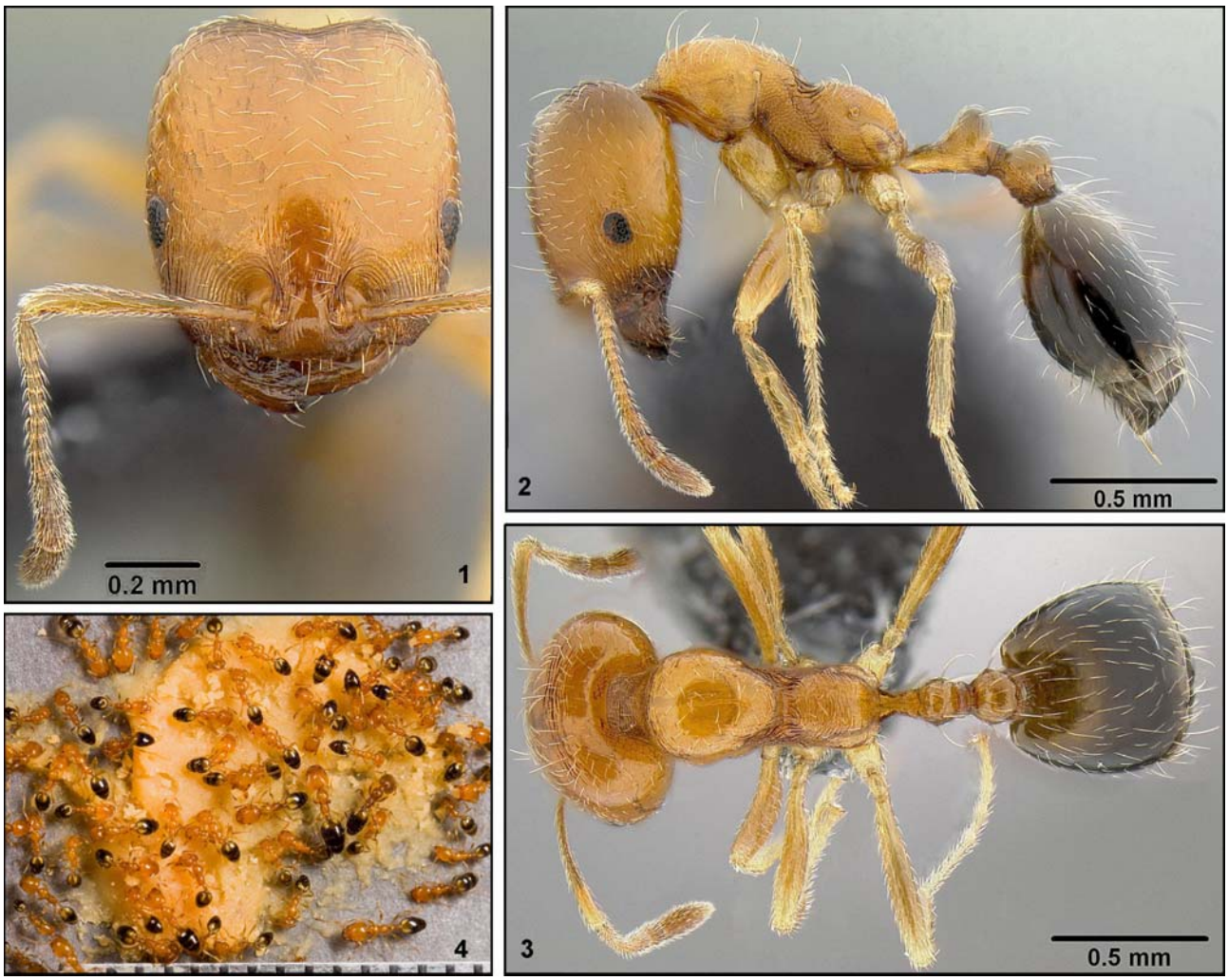
Introduction

Numerous ant species have spread around the world through human commerce. Among the best known and most destructive are the African big-headed ant, *Pheidole megacephala* (FABRICIUS, 1793) (WETTERER 2007), the little fire ant, *Wasmannia auropunctata* (ROGER, 1863) (WETTERER & PORTER 2003), the red imported fire ant, *Solenopsis invicta* BUREN, 1972 (ALLEN & al. 2004), and the Argentine ant, *Linepithema humile* (MAYR, 1868) (HUMAN & GORDON 1997). While surveying ants on tropical Atlantic and West Indian islands, I encountered numerous outbreaks of another destructive pest ant, *Monomorium destructor* (JERDON, 1851). For example, on the Cape Verde Islands, many people readily shared stories about how these ants recently appeared in their homes, living in their walls and appliances, and eating virtually anything around the house, including food, insulation on electrical wires, and the fabric of furniture and clothing. Numerous Cape Verde residents reported being attacked by these ants in their gardens and homes, and even while in bed. In areas of outbreak in Cape Verde, *M. destructor* was well known to locals as the "ninja ant." Here, I evaluate the worldwide spread and possible geographic origin of *M. destructor*.

JERDON (1851) first described *M. destructor*, reporting it was "common in all parts of India." WROUGHTON (1892) wrote that *M. destructor* was common in houses in South India, but in northern India "above the Ghâts, it is a wild species, but not common." Most subsequent authors have concluded that *M. destructor* probably originated in Asia (EMERY 1893a, WHEELER 1906, MAYOR 1922, KUSNEZOV 1949, SMITH 1965, DLUSSKY & ZABELIN 1985, BOLTON 1987, FOWLER & al. 1994, COLLINGWOOD & al. 2004). For example, COLLINGWOOD (1962) reported *M. destructor* (as junior synonym *Monomorium gracillimum* (SMITH, 1861)) from Kambaiti, Burma, and concluded "the species would seem to be truly indigenous in Burma since the specimens were collected in a mountain area." RUZSKII (1907) wrote that *M. destructor* (as *M. gracillimum*) probably originated in Southeast India, and from there, spread West to Africa through Persia, Syria, and Arabia, as well as southern Europe and Polynesia. BERNARD (1944, 1948) wrote that *M. destructor* (as *M. gracillimum*) was originally from the steppes and deserts of central Asia and was in the process of invading the entire Sahara and surrounding regions. BERNARD (1958, 1960) gave a more precise origin, writing that *M. destructor* (as *M. gracillimum*) was introduced from Iran to North Africa in the 19th century.

In contrast, FOREL (1909) reported *M. destructor* (as *M. gracillimum*) among native plants in a desert area near Biskra, Tunisia, and speculated that the species was native to North Africa, having spread westward from Egypt. Although WILSON (1962) wrote that *M. destructor* probably originated in tropical Asia, WILSON & TAYLOR (1967) later concluded that *M. destructor* "probably originated, like other members of the subgenus *Parholcomyrmex*, from Af-



Figs. 1 - 4: *Monomorium destructor*. (1) head of major worker; (2) lateral view of major worker; (3) dorsal view of major worker; (4) workers on peanut butter bait, Lautoka, Fiji (photos by E. Sarnat).

rica." DLUSSKY (1994) also concluded that *M. destructor* was African in origin. Following DLUSSKY (1994), WETTERER & VARGO (2003) listed *M. destructor* as an African species.

When evaluating the native and exotic ranges of a species, researchers may consider a spectrum of distributional, historical, evolutionary, ecological, and genetic information (see WETTERER 2008). Evidence considered indicative of a species' native range includes older records largely confined to a single continuous geographic region, occurrence in inland native communities, high genetic diversity, co-occurrence of species-specific symbionts, and proximity to the ranges of closely related species. In contrast, evidence indicative of a species' exotic range includes the sudden appearance and spread of the species through an area discontinuous with other known populations, occurrence exclusively in coastal and highly disturbed environments, low genetic diversity due to a founder effect, absence of species-specific symbionts, and geographic isolation from closely related species.

Taxonomy

Monomorium destructor workers (Figs. 1 - 4) are distinctly bi-colored: light yellow to yellow-brown, except for the rear two-thirds or so of the gaster, which is dark brown to nearly black. Workers are polymorphic, showing a wide size range and distinct allometry, readily identified by the fine transverse striae on the vertex and deep metanotal groove (BOLTON 1987, FERNÁNDEZ 2007). Junior synonyms of *M. destructor* include *Monomorium basale* SMITH, 1858 from Sri Lanka (synonymized by FOREL 1894), *Myrmica ominosa* GERSTÄCKER, 1859 and *Myrmica atomaria* GERSTÄCKER, 1859 both from Mozambique (both synonymized by DALLA TORRE 1893), *Monomorium vexator* SMITH, 1861 from Indonesia (synonymized by DONISTHORPE 1942), and *Myrmica gracillima* from Syria or Palestine – site not given (synonymized by BOLTON 1987).

Methods

To document the geographic distribution of *M. destructor*, I used both published and unpublished records. Some published reports of *M. destructor* from Africa and the Arabian Peninsula may be misidentifications of closely related *Monomorium* species. I obtained unpublished site records from museum specimens in the collections of the American Museum of Natural History (AMNH), the Archbold Biological Station (ABS), the British Natural History Museum (BMNH), the Museum of Comparative Zoology

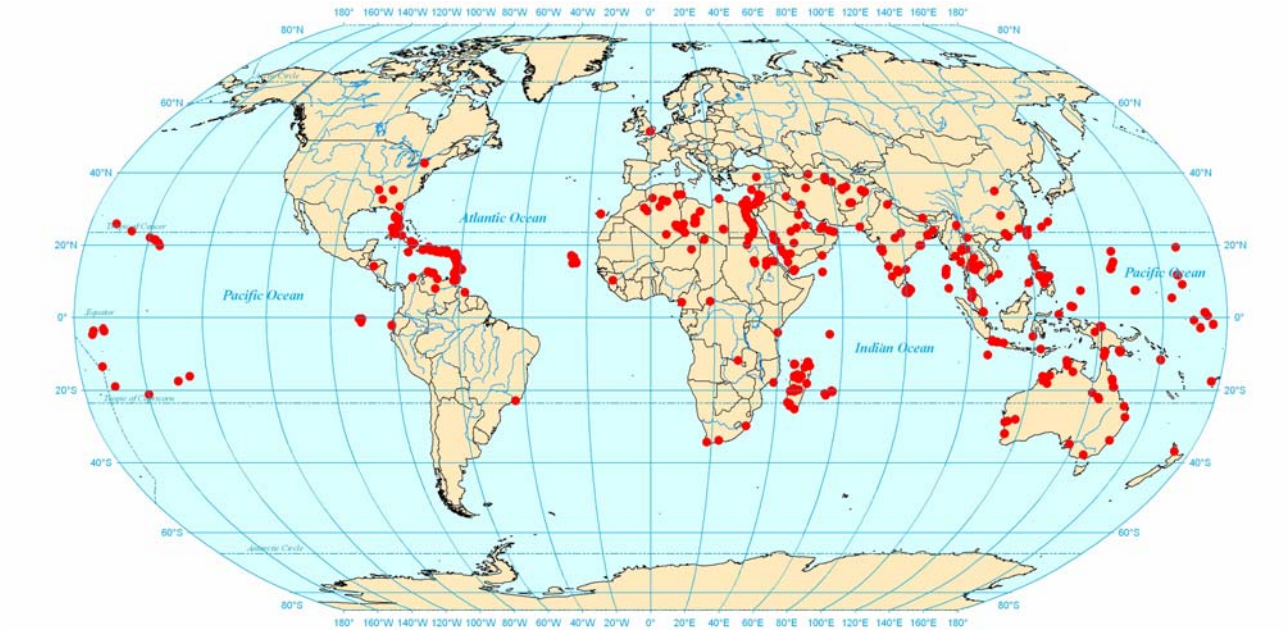


Fig. 5: Worldwide distribution of *Monomorium destructor* (some African and Middle Eastern records may be misidentifications of related species).

(MCZ), the National Museums Liverpool (NML), the Oxford University Natural History Museum (ONHM), and the Smithsonian Institute's National Museum of Natural History (SI). In addition, I used on-line databases with collection data of specimens in the Australian National Insect Collection (ANIC) and the California Academy of Sciences (CAS). I also received unpublished records from B. Taylor (Egypt), O. Paknia (Iran), J. Miles (Palau), J. Lewallen (Vietnam), B. Hoffmann (Australia), W. Haines (Hawaii), J. Fellowes (China), and M. Angela (Aruba). Finally, I collected *M. destructor* specimens on the Cape Verde islands, on numerous Caribbean Islands, and in Florida.

Geographic coordinates for collection sites came from published references, from specimen labels, or I looked up the coordinates using maps and geography web sites (e.g., earth.google.com, www.tageo.com, and fallingrain.com). For older references and specimens, many site names, particularly in Asia, 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. Often, if one source had many sites less than 10 - 20 km apart (e.g., ALFIERI 1931, CLOUSE 2007, my collection sites in Cape Verde), I did not plot every site. I did not map records of *M. destructor* on boats or intercepted in transit by quarantine inspectors. I excluded several specimen records originally identified as *M. destructor* that BOLTON (1987) subsequently identified as *Monomorium mayri* FOREL, 1902. Undated specimens collected by Theodore Pergande in Honduras and Martinique must have been collected before Pergande's death in 1916. A specimen from Mombassa, Kenya, identified by Forel, was collected before Forel's death in 1931.

Results

I mapped specimen records of *M. destructor* from > 600 sites worldwide (Fig. 5). Specimen records of *M. destructor* came from 107 geographic areas (i.e., countries, island groups, major Caribbean islands, and US states). These include many areas for which I found no previously published records, e.g., Bahamas, Barbuda, Barbados, Bonaire, Comoro Islands, Curaçao, Grenada, Haiti, Honduras, Kenya, Nevis, Pakistan, Réunion, St. Lucia, St. Martin, St. Vincent, and Venezuela (Tabs. 1 - 7). Despite being relatively simple to distinguish, some *M. destructor* specimens in the MCZ had been previously identified as *Monomorium pharaonis* (LINNAEUS, 1758), and it is possible that some reports of *M. pharaonis* in the literature were misidentified *M. destructor*. I did not find any *M. pharaonis* specimens in the MCZ misidentified as *M. destructor*. Because *M. pharaonis* is much more widely-known as a pest than *M. destructor*, it seems unlikely that many reports of *M. destructor* in the literature were actually misidentified *M. pharaonis*. One exception is the record of *M. destructor* at Archbold Biological Station, Florida in EISNER & al. (1980), which was actually *M. pharaonis* (M. Deyrup, pers. comm.).

Few records of *M. destructor* come from temperate areas (Fig. 5). The highest latitude records are from indoor populations in England (London: one record from a clothes warehouse and another from a switch box, and Kew Gardens; 51.5 °N; DONISTHORPE 1911) and one report from Dansville, New York (42.6 °N; USBEPQ 1962) that indicated "it is doubtful, however, if the species will survive out-of-doors in New York." RUZSKII (1923) reported the highest latitude outdoor record of *M. destructor* (as *M. gracillimum*) from a sandy spit by the Caspian Sea in Cheleken, Turkmenistan (39.4 °N). DLUSSKY & ZABELIN (1985) reported *M. destructor* (as *M. gracillimum*) from western Kopet Dag, Turkmenistan, and Qashqadaryo, Uzbekistan (both 38 - 39 °N). PISARSKI (1967, 1969) listed *M. destructor* (as *M. gracillimum*) from five sites in Afghanistan from 35.1 to 36.0 °N. The only other records of *M. destructor* at temperate latitudes > 35 ° come from urban areas: Melbourne, Australia (37.8 °S; CLARK 1941), Auckland, New Zealand (36.9 °S; HEMBRY 2005), and two cities in Tennessee (Chattanooga: 35.1 °N; Memphis: 35.2 °N; see Tab.

Tab. 1: Earliest known records for *Monomorium destructor* from Asia and neighboring islands. Unpublished records include collector, museum source, and site. BMNH = Natural History Museum in London, MCZ = Museum of Comparative Zoology, SI = Smithsonian Institute. + = no known published record.

	Earliest record
India	≤ 1851 (JERDON 1851)
Sri Lanka	≤ 1858 (SMITH 1858; as *M. basalis*)
Philippines	1858 (MAYR 1865; as *M. basale*)
Indonesia	≤ 1861 (SMITH 1861b; as *M. vexator*)
Turkmenistan	≤ 1877 (MAYR 1877; as *M. gracillimum*)
Burma/Myanmar	1885-87 (EMERY 1889; as *M. gracillimum*)
Singapore	1899 (Haviland, BMNH): no site
Iran	≤ 1907 (RUZSKII 1907; as *M. gracillimum*)
Vietnam	≤ 1907 (FOREL 1907; as *M. gracillimum*)
Taiwan	≤ 1909 (WHEELER 1909)
China	≤ 1927 (WHEELER 1927)
Thailand	1928 (H. Hillman, SI): Bangkok
Christmas I.	1933 (DONISTHORPE 1935)
Japan	≤ 1948 (BERNARD 1948)
Afghanistan	1948 (COLLINGWOOD 1961; as *M. gracillimum*)
Papua New Guinea	1957 (WILSON & TAYLOR 1967)
Nepal	1962 (R.L. Coe, BMNH): Taplejung
Bangladesh	≤ 1967 (ALAM 1967 in HANNAN 2003)
Uzbekistan	≤ 1985 (DLUSSKY & ZABELIN 1985; as *M. gracillimum*)
Hainan Island	≤ 1995 (WU & WANG 1995)
Malaysia	≤ 1997 (WAY & BOLTON 1997)
+ Pakistan	2007 (S & Z Valliani, MCZ): Karachi

7). RUZSKII (1907) reported *M. destructor* (as *M. gracillimum*) from Southern Europe, but this location was too general for me to place a point on the map. ESPADALER (2005) reported *M. destructor* intercepted and exterminated in Barcelona, Spain (41.3 °N) in a shipment from Busan, South Korea (35.1 °N), but gave no indication that *M. destructor* was established at either site, so I did not map them.

In Cape Verde, I collected *M. destructor* in urban areas on six of the nine inhabited islands: Santiago, São Vicente, Santo Antão, São Nicolau, Fogo, and Brava. In the West Indies, I found *M. destructor* at scattered sites on most islands visited, usually in urban areas. My specimens were the first records of *M. destructor* for several islands (Tab. 5).

Although *M. destructor* workers readily tend a wide range of Hemiptera and Lepidoptera (e.g., WROUGHTON 1892, DEYRUP & al. 2000, FIEDLER 2006), I found no records of any species-specific symbionts associated with *M. destructor*.

Tab. 2: Earliest known records for *Monomorium destructor* from North Africa, the Middle East, and neighboring islands. Abbreviations as in Table 1. Some records from this region may be misidentifications of closely related species.

	Earliest record
Palestine or Syria	1860 (SMITH 1861a; as *M. gracillima*)
Egypt	≤ 1862 (MAYR 1862; as *M. gracillimum*)
Palestine/Israel	≤ 1863 (ROGER 1863; as *M. gracillimum*)
Syria	≤ 1877 (MAYR 1877; as *M. gracillimum*)
Asian Turkey	≤ 1877 (MAYR 1877; as *M. gracillimum*)
Eritrea	≤ 1877 (EMERY 1877; as *M. basale*)
Yemen	1880 (EMERY 1881; as *M. gracillimum*)
Algeria	≤ 1883 (ANDRÉ 1883; as *M. gracillimum*)
Sudan	≤ 1884 (MAGRETTI 1884; as *M. gracillimum*)
Canary Islands	≤ 1892 (EMERY 1893b)
Tunisia	≤ 1908 (EMERY 1908; as *M. gracillimum*)
Iraq	1917 (CRAWLEY 1920; as *M. gracillimum*)
Libya	1931 (MENOZZI 1932; as *M. gracillimum*)
Chad	≤ 1948 (BERNARD 1948)
Niger	≤ 1950 (BERNARD 1950; as *M. gracillimum*)
Saudi Arabia	1975 (COLLINGWOOD 1985; as *M. gracilimum*)
Cape Verde	1983 (M.L. Lobo Lima, BMNH): Mindelo
Lebanon	≤ 1988 (KUGLER 1988; as *M. gracillimum*)
Kuwait	1988-89 (COLLINGWOOD & AGOSTI 1996)
United Arab Emirates	1995 (COLLINGWOOD & al. 1997)
Cyprus	≤ 2000 (CAB 2000 in DAFF 2001)

Related *Monomorium* species

In addition to *M. destructor*, BOLTON (1987) placed five other species in the *Monomorium destructor* species-group: *M. mayri*, *M. oscaris* FOREL, 1894, *M. robustior* FOREL, 1892, *M. emeryi* MAYR, 1895, and *M. epinotale* SANTSCHI, 1923. Four members of the group (*M. oscaris*, *M. ro-*

Tab. 3: Earliest known records for *Monomorium destructor* from sub-Saharan Africa and neighboring islands. Abbreviations as in Table 1, and CAS = California Academy of Sciences, MP = Museum Paris, ZSM = Zoologische Staatssammlung München. Some records from this region may be misidentifications of closely related species.

	Earliest record
Mozambique	≤ 1858 (GERSTÄCKER 1859; as *M. ominosa* & *M. atomaria*)
South Africa	≤ 1862 (MAYR 1862; as *M. gracillimum*)
Madagascar	1899 (Grandidier, MP): site unknown
Guinea	≤ 1914 (SANTSCHI 1914; as *M. gracillimum*)
+ Kenya	≤ 1931 (Prager, ZSM): Mombassa
Central African Rep.	1948 (WEBER 1964)
Congo (Zaire)	1948 (WEBER 1964)
Mauritius	1953 (MAMET 1954)
Seychelles	1975 (MÜHLENBERG & al. 1977)
Cameroon	≤ 2006 (KENNE & al. 2006)
+ Réunion	2007 (B.L. Fisher, CAS): Le Port
+ Comoro Islands	2007 (B.L. Fisher, CAS): Mayotte; Tanaraki

Tab. 4: Earliest known records for *Monomorium destructor* from Australia and Pacific Ocean islands. Abbreviations as in Table 1.

	Earliest record
Hawaii	1896-97 (EMERY 1899)
Australia	≤ 1910 (FOREL 1910)
Mariana Islands	1911 (WHEELER 1912)
Society Islands	1925 (WHEELER 1936)
Cook Islands	1925 (WILSON & TAYLOR 1967)
FS Micronesia	1937 (CLOUSE 2007)
Marshall Islands	1947 (COLE 1949)
Solomon Islands	1953 (WILSON 1962)
Gilbert Islands	1956 (E.S. Brown, BMNH): Tarawa
Wake Island	1957 (WILSON & TAYLOR 1967)
Samoa	1962 (WILSON & TAYLOR 1967)
Tuamotu Islands	1996 (MORRISON 1997)
Niue	1996 (COLLINGWOOD & VAN HARTEN 2001)
Galapagos	1997 (PEZZATTI & al. 1998)
Fiji	2004 (WARD & WETTERER 2006)
New Zealand	2004-5 (HEMBRY 2005)
Palau	≤ 2005 (OLSEN & MILES 2005)
Phoenix Islands	2006 (PIERCE & al. 2006)

bustior, *M. emeryi* and *M. epinotale*) are known only from sub-Saharan Africa (BOLTON 1987). BOLTON (1987) recorded *M. mayri* from Africa, the Arabian Peninsula, and Asia.

Morphologically, *M. destructor* most closely resembles *M. mayri*, *M. oscaris*, and *M. robustior*, though the latter three species are uniform in color, not bi-colored like *M. destructor* (BOLTON 1987). BOLTON (1987) wrote that *M. mayri* matched "the description of *destructor* in all respects except colour, *mayri* being uniformly dark brown, sometimes with a paler patch at the base of the first gastral tergite. I have decided to retain *mayri* as a valid species, separate from *destructor*, for the time being. The colour character is admittedly feeble but appears to be consistent." BOLTON (1987) concluded: "the closest relative of *oscaris* appears to be the pantropical tramp-species *destructor*, but the two are separable by the shape of the petiole node in dorsal view, especially in larger workers. In *destructor* the node is globular to subglobular but in *oscaris* it is strongly anteroposteriorly compressed and markedly transverse. Also, at any given worker size, the scapes tend to be longer in *destructor* than *oscaris*." BOLTON (1987) reported: "the colour and habitus of *robustior* approaches that of *mayri* most closely." However, several other characters of *M. robustior* differ from those of *M. destructor* and *M. mayri*: *M. robustior* has a narrower worker size range, larger eyes, and longer hairs on the first gastral tergite (BOLTON 1987). Several specimens identified as *M. destructor* by earlier authors (e.g., from Egypt; DONISTHORPE 1942), BOLTON (1987) re-identified as *M. mayri*. It seems likely that other records of *M. destructor* may also be misidentified *M. mayri* (if this is, in fact, a valid species), particularly specimens originally identified as *M. gracillimum*, a slightly darker variant of *M. destructor*.

Many questions persist concerning the taxonomy of *M. destructor* and its close relatives. BOLTON (1987) wrote: "it is possible that the names *ominosa* and *atomaria*, both described from East Africa and subsequently synonymized with *destructor*, may represent early records of [*Monomorium*] *oscaris*. However, as the original descriptions are so poor, and as the specimens involved seemingly have long since disappeared, there is no way of proving this; in consequence they are left undisturbed as junior synonyms of *destructor*." Although I believe it is very likely that *M. ominosa* and *M. atomaria* are not *M. destructor*, but rather one of its close relatives that are much more common in sub-Saharan Africa, I have followed BOLTON (1987) and included these records.

In Nigeria and Ghana, ROOM (1971), MAJER (1976), and TAYLOR (1981) reported a common forest ant species that they designated *Monomorium* sp. G. BOLTON (1987) subsequently assigned *Monomorium* sp. G to *M. oscaris*, with the caveat that ants of this West African population

Tab. 5: Earliest known records for *Monomorium destructor* from the West Indies. Abbreviations as in Table 1, and AMNH = American Museum of Natural History.

	Earliest record
Jamaica	≤ 1893 (ANDRE 1893; as *M. basale*)
Puerto Rico	1908 (SMITH 1936)
Martinique	≤ 1916 (T. Pergande, SI): site unknown
Cuba	1918 (W.M. Mann, SI): El Caney
Antigua	1918 (WHEELER 1923)
+ Haiti	1926 (C.N. Wolcott, SI): Port au Prince
Dominican Republic	1929 (MENOZZI & RUSSO 1930)
Virgin Islands	1937 (BEATTY 1944)
Trinidad	1948 (BMNH): site unknown
+ Nevis	1967 (N.L.H. Krauss, SI): site unknown
+ Montserrat	1967 (N.L.H. Krauss, SI): Plymouth
+ Bahamas	no date (N. Krauss, AMNH): Nassau
+ Barbuda	no date (Jefferys, BMNH): site unknown
Guadeloupe	1986-87 (JAFFE & al. 1991)
+ Bonaire	1999 (E. Scholtens & B. Krause, MCZ): Kaya Otomac
+ Barbados	2003 (J.K. Wetterer, MCZ): Black Rock
+ Grenada	2003 (J.K. Wetterer, MCZ): St. George's
+ Tobago	2003 (J.K. Wetterer, MCZ): Bon Accord
+ St Lucia	2003 (J.K. Wetterer, MCZ): Pointe Hardy
+ St Vincent	2004 (J.K. Wetterer, MCZ): Calliaqua
+ Curaçao	2004 (J.K. Wetterer, MCZ): Ascension
+ St Kitts	2007 (J.K. Wetterer, MCZ): Major's Bay
+ Aruba	2007 (J.K. Wetterer, MCZ): Palm Beach

"may eventually prove to be separable at the species-level from the eastern and southern population" of *M. oscaris*. *Monomorium* sp. G, however, is distinctly bi-colored (TAYLOR 2007). Although *Monomorium* sp. G differs from *M. destructor* in having only a narrow range of small workers with a different allometry, TAYLOR (2007) provisionally regarded them as conspecific with *M. destructor*. Here, however, I have been conservative and followed BOLTON (1987) in considering *Monomorium* sp. G as distinct from *M. destructor*.

In addition to *M. destructor*, several other *Monomorium* are considered major tramp species, e.g., *Monomorium floricola* (JERDON, 1851), *M. monomorium* BOLTON, 1987, *M. pharaonis*, *M. sechellense* EMERY, 1894, and *M. subopacum*

Tab. 6: Earliest known records for *Monomorium destructor* from South and Central America. Abbreviations as in Table 1.

	Earliest record
Brazil	≤ 1895 (FOREL 1895)
+ Honduras	≤ 1916 (T. Pergande, SI): site unknown
+ Venezuela	1930 (J.G. Myers, MCZ): San Fernando de Apure
Ecuador	≤ 1960 (KEMPF 1960)
Colombia	≤ 1972 (KEMPF 1972)

Tab. 7: Earliest known records for *Monomorium destructor* from the United States and Europe. Abbreviations as in Table 1.

	Earliest record
Alabama	≤ 1905 (WHEELER 1906)
Florida	≤ 1905 (WHEELER 1906)
Southern Europe	≤ 1907 (RUZSKII 1907; as *M. gracillimum*)
England	1910 (DONISTHORPE 1911)
Tennessee	1932 (L.C. Murphree, SI): Memphis & Chattanooga
New York	1961 (USBEPQ 1962

(SMITH, 1858). *Monomorium destructor* superficially resembles the widespread pharaoh ant, *M. pharaonis*. *Monomorium pharaonis* workers vary in color, even within a single colony, from uniform yellow to yellow with a dark brown rear of the gaster. *Monomorium destructor*, however, can be easily distinguished from *M. pharaonis* because the head, alitrunk and pedicel of the workers are almost entirely smooth and shiny in *M. destructor*, but are matte (not shiny) in *M. pharaonis*. In addition, *M. destructor* has a much broader range of worker size than does *M. pharaonis* (*M. destructor*: 1.8 - 3.5 mm length; *M. pharaonis*: 2.2 - 2.4 mm length; BOLTON 1987).

Discussion

Distribution and impact

Monomorium destructor has a widespread distribution in tropical and subtropical parts of the Old World, except in sub-Saharan Africa. In the New World, however, it is widespread only in Florida, the West Indies, and the Galapagos Islands (Fig. 5).

In the past, *M. destructor* was primarily spread by ship. For example, CLARKE (1922) reported *M. destructor* was a serious problem on steamers traveling between California and the East Coast US via Panama Canal, writing that *M. destructor* "not only caused a considerable pecuniary loss in the destruction of food stuffs but attacked passengers and crew… They would find their way in small or large numbers into the beds and their bites were very painful." WEBER

(1939) found live *M. destructor* in his luggage in Massachusetts several days after returning from Cuba by ship (not mapped). Now, air travel, combined with the ant's propensity of nesting in electrical and electronic equipment, allows the possible spread of *M. destructor* to virtually anywhere in the world. For example, ENGST (2005) reported that, on arrival in New Zealand, an air passenger found *M. destructor* living inside a sealed iPod bought in the airport in Fiji.

I found little information concerning possible impacts of *M. destructor* in natural ecosystems, though there is ongoing research in the Galapagos Islands, where expanding *M. destructor* populations have caused concern (e.g., VON AESCH & CHERIX 2005).

In contrast, I found many reports of *M. destructor* destroying property and attacking people. For example, STONEY (1995) wrote that in Western Australia, *M. destructor* "has been known to chomp through a grown man's thong overnight and chew up anything from polystyrene cups to wiring in cars, telephones and houses... The insect has even nibbled on newborn babies sleeping in their cots and left big holes in car tyres. 'Kids are virtually being eaten alive while they sleep at night,' the Derby shire president, Mr. Peter McCumstie, said." CHIN (1998) wrote how in Darwin, Australia, *M. destructor* "can cause havoc in the household since they bite and may occur almost everywhere inside the house, feeding on a wide variety of food materials. They frequently nest in power sockets and chew on electrical wiring and in some cases have started electrical fires." In the community of Nguiu on Bathurst Island, Australia, B. Hoffmann investigated an enormous outbreak of *M. destructor* (CSIRO 2003). Hoffmann reported, "The magnitude of damage is really overwhelming… There were massive trails going into houses from all directions – millions and millions of Singapore ants [*M. destructor*] swarming everywhere. These ants get into power points, they eat electrical wiring and short-circuit the power – two houses have already burned down recently because of damage caused to electrical systems" (ANONYMOUS 2003). On Tobi Island and Helen Reef Atoll in Palau, BOUDJELAS (2006) reported that *M. destructor* was a serious threat to essential infrastructure and "causes extensive economic damage in human settlements by damaging fabric and rubber goods and removing insulation from electric cables." LEE & al. (2002) found that in surveys of food preparation outlets on Penang Island, Malaysia, *M. destructor* was the dominant ant species, making up 27.8% of the ant specimens collected.

In the Dry Tortugas, the outermost of the Florida Keys, MAYOR (1922) reported that *M. destructor* on Loggerhead Key was "a great pest in the wooden buildings of Tortugas Laboratory, making its nests in crevices of the woodwork. So voracious are these insects that we are obliged to swing our beds from the rafters and to paint the ropes with a solution of corrosive sublimate, while all tables must have tape soaked in corrosive sublimate wrapped around their legs if ants are to be excluded from them. These pests have the habit of biting out small pieces of skin, and I have seen them kill within 24 hours rats which were confined in cages." At Tortugas Laboratory, "one of the scientists, a newcomer who allowed his sheet to touch the floor, was stung so badly by a swarm of them that he lapsed into unconsciousness for a while" (STEPHENS & CALDER 2006). The Tortugas Laboratory buildings were later abandoned and torn down. Remarkably, no subsequent collector found *M. destructor* on Loggerhead Key (WETTERER & O'HARA 2002). Elsewhere in the Florida Keys, DEYRUP (1991) wrote that *M. destructor* "is spectacularly common on Key West." In a recent visit to Key West, however, I was unable to find any *M. destructor*. Instead, all areas where I collected on Key West were dominated by *P. megacephala* and/or *S. invicta* (J.K. Wetterer, unpubl.).

Monomorium destructor populations appear to be expanding in the West Indies (see Tab. 5), where they are a serious household problem. For example, in my apartment in Tunapuna, Trinidad, enormous trails of *M. destructor* foragers streamed out of an electrical socket and into the cupboards, trashcan, and kitchen sink, carrying off any scrap of food they could find. In an electronics store in Aripo, Trinidad, the owners reported this species nesting inside their computers. In a hotel room in Grand Anse, Grenada, a large trail of *M. destructor* emerged out of the air-conditioner to forage in my trashcan. In addition to urban areas, I also found *M. destructor* swarming down trees in parks and disturbed forests, for example in beachfront parks on Grenada, St. Croix, St. Vincent, and St. Lucia and in a forest of the poisonous manchineel tree (*Hippomane mancinella* LINNAEUS, 1753) on Curaçao.

Native and exotic range

There is consensus that *M. destructor* originated in the Old World, but disagreement as to where in the Old World it is native (see Introduction). Because *M. destructor* was already known from many sites in both Asia and Africa in the 19th century (Tabs. 1 - 3), when the world's ant fauna was still very poorly documented, determining its native range and reconstructing its early spread as an exotic is not possible using specimen records alone.

The close resemblance between *M. destructor* and several African species (BOLTON 1987) supports the proposal that *M. destructor* originated in Africa. However, DLUSSKY & ZABELIN (1985) wrote that the distribution of its closest (unspecified) relatives suggested that *M. destructor* (as *M. gracillimum*) originated in Indo-Malaysia. In fact, *M. destructor* shows a fairly continuous distribution from North Africa, across the Middle East and Central Asia, all the way to Southeast Asia. Throughout this region, it occurs in diverse natural and disturbed habitats. For example, COLLINGWOOD & AGOSTI (1996) wrote that *M. destructor* "abounds throughout Arabia and seems to occur in every type of habitat with many collections from Saudi Arabia, Oman and Yemen."

There seems to be little rationale for considering *M. destructor* native to Asia, but exotic to North Africa. Part of the explanation for past researchers considering only Asia as the original native range of *M. destructor* may be that many *M. destructor* specimens, particularly from North Africa and Arabia, were originally identified as *M. gracillimum* (e.g., see Tab. 2). Thus, before BOLTON (1987) designated *M. gracillimum* to be a junior synonym of *M. destructor*, most known Old World records of *M. destructor* came from Asia.

Records of *M. destructor* from sub-Saharan Africa are rare and some of these may be misidentifications (Fig. 5; see Results). HETERICK (2006) considered *M. destructor* to be introduced to Madagascar. It seems likely that *M. destructor* is not native to sub-Saharan Africa as well. It also

seems likely that *M. destructor* is exotic to Australia and Oceania (WILSON & TAYLOR 1967). Whether or not *M. destructor* is native to East and Southeast Asia (including Singapore) is an open question. Future research on the genetic diversity of *M. destructor* populations in different parts of the world and the phylogeny of *Monomorium* should help elucidate further the native and exotic ranges of *M. destructor*.

Common names

Although most authors have used no common name for *M. destructor*, some reports have used the name "Singapore ant" (e.g., HOFFMANN & O'CONNOR 2004, BOUDJELAS 2006; however, CHIN (1998) used this name for both *M. destructor* and *M. floricola*). I could find no notable connection between *M. destructor* and Singapore to explain this common name. In the earliest use of "Singapore ant" that I found, BASEDOW (1918) wrote of "the so-called 'Singapore ant,' whose tiny dimensions were by no means in proportion to their voracity." Unfortunately, BASEDOW (1918) did not include the Latin name for this species. In the earliest association I found between a particular ant species and the name "Singapore ant," CLARK (1938) wrote of "*Monomorium pharaonis*, the well known house pest, a minute yellow ant, commonly known in Australia as the Singapore Ant."

The name Singapore ant may have become associated with *M. destructor* due to the mistaken synonymy of *Myrmica vastator* SMITH, 1857 (= *M. pharaonis*), which was described from Singapore. WROUGHTON (1892) considered *M. vastator* a synonym of *M. basale* (= *M. destructor*) and DALLA TORRE (1893) synonymized *M. vastator* with *M. destructor,* apparently based on mislabeled specimens in the British Museum. DONISTHORPE (1932), however, concluded "it is clear that the type of *M. vastator* Smith is at Oxford, and that the species is really *M. pharaonis* L."

Although FOREL (1911) reported *M. destructor mayri* (= *M. mayri*) from Singapore, the earliest publication I found reporting true *M. destructor* from Singapore was BOLTON (1987), who listed the collection site as Sabang, a locale I could not confirm (though there are eight towns named Sabang in neighboring Indonesia and one in Malaysia). I did, however, find museum specimens of *M. destructor* from Singapore (collected in 1899 and 1933; e.g., Tab. 1).

The common name "ninja ant," used in Cape Verde for *M. destructor*, comes from the Ninja of feudal Japan, spies and assassins trained in martial arts, and popularized in many recent movies and cartoons. This name, no doubt, relates to these ants' vicious attacks on people. Unfortunately, this common name, like "Singapore ant," implies a specific Asian origin of this species, which is far from certain.

DEYRUP & al. (2000) proposed a new common name for *M. destructor*: the "destructive trailing ant." Here, I propose a simpler, yet distinctive common name, based directly on its Latin name: the "destroyer ant." The equivalent Spanish common name would include its specific Latin name: "hormiga destructor."

Future trends

Monomorium destructor appears to be most common as a serious pest in disturbed arid habitats in the tropics and subtropics, including Cape Verde, North Africa, the Middle East, Pakistan, India, the Galapagos, and the Florida Keys, but is also a house pest in more humid regions. Adaptation to arid habitats may preadapt *M. destructor* to thrive in dry indoor conditions. Although *M. destructor* is not yet known from many tropical and subtropical areas (Fig. 5), I expect that it will continue to spread, particularly in arid areas such the Pacific coast of Central and South America and much of Mexico.

The disappearance of *M. destructor* on Loggerhead Key (see above) suggests that outbreaks may be relatively short-lived. DEYRUP & al. (1988) wrote that *M. destructo*r may be on the decline in the Florida Keys, and ESPADALER & BERNAL (2003) noted that *M. destructor* had not been recorded in the Canary Islands for many years. A similar decline might be expected in areas currently experiencing great outbreaks of *M. destructor*, including Cape Verde, Bathurst Island, and Tobi Island. This pattern of population explosion followed by decline should be taken into consideration in any large-scale efforts to control these ants.

Future research on the phylogeny of *Monomorium*, and on the genetic diversity of *M. destructor* populations in different parts of the world should help elucidate further the native and exotic ranges of this species.

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Zusammenfassung

Die Ameisenart *Monomorium destructor* (JERDON, 1851), auch "destroyer ant" genannt, ist ein Lästling in vielen tropischen und subtropischen Gebieten, wo sie für das Abnagen der Isolation von elektrischen Leitungen, das Behausen und Zerstören von Elektrogeräten und das Attackieren von Menschen berüchtigt ist. Ich habe veröffentlichte und unveröffentlichte Nachweise von > 600 Fundorten weltweit verortet, um die Ausbreitung von *M. destructor* zu evaluieren. Ich habe die frühesten bekannten Nachweise von *M. destructor* für 107 geographische Gebiete (Länder, Inselgruppen, große karibische Inseln und US-Bundesstaaten) zusammengetragen, einschließlich vieler, für die ich keine bisher veröffentlichten Nachweise gefunden habe: Bahamas, Barbados, Barbuda, Bonaire, Curaçao, Grenada, Haiti, Honduras, Kenia, Komoren, Nevis, Pakistan, Réunion, St. Lucia, St. Martin, St. Vincent, Tobago und Venezuela. *Monomorium destructor* hat die größte morphologische Ähnlichkeit mit mehreren afrikanischen *Monomorium*-Arten und eine offenbar durchgehende Verbreitung von Nordafrika bis Südostasien. Diese Umstände weisen auf Nord-

afrika als Ursprung von *Monomorium destructor* hin, aber machen auch wahrscheinlich, dass die Art auch im Gebiet von Mittel-Ostasien bis Südasien nativ ist. *Monomorium destructor* tritt als Lästling am häufigsten in menschlich überprägten ariden bis semi-ariden Lebensräumen der Tropen und Subtropen auf. Vorkommen von *M. destructor* scheinen oft lokal begrenzt und kurzlebig zu sein. Dieses Muster einer explosiven Populationsentwicklung gefolgt von einer Abnahme der Population sollte bei großräumigen Bekämpfungsmaßnahmen gegen die Art berücksichtigt werden.

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