

Worldwide spread of the tropical fire ant, *Solenopsis geminata* (Hymenoptera: Formicidae)

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Abstract

The tropical fire ant, *Solenopsis geminata* (FABRICIUS, 1804), is a well-known pest in many parts of the world, where it is notorious for its potent sting. To evaluate the worldwide spread of *S. geminata*, I compiled and mapped published and unpublished specimen records from > 2100 sites. I documented the earliest known *S. geminata* records for 122 geographic areas (countries, island groups, major Caribbean islands, US states, and Canadian provinces), including several areas for which I found no previously published records, e.g., Anguilla, Barbuda, Curaçao, Madagascar, Montserrat, Nebraska, Nevis, St Martin, and Vanuatu. Several New World *Solenopsis* species were once considered junior synonyms of *S. geminata* (e.g., *S. gayi* (SPINOLA, 1851), *S. saevissima* (SMITH, 1855), *S. virulens* (SMITH, 1858), and *S. xyloni* MCCOOK, 1880). Therefore, I did not map unconfirmed New World *S. geminata* records published before CREIGHTON's (1930) revision of *Solenopsis* from areas where these species occur, because some of these early records were likely to be based on misidentifications.

Solenopsis geminata records are common through much of the New World tropics as well as parts of subtropical North America. Whereas *S. geminata* is certainly native to South and Central America, it may well be exotic to the southeastern US and the West Indies, introduced several hundred years ago. By 1900, *S. geminata* had also spread through many parts of the Old World, notably tropical Asia and Oceania.

In the mid-20th century, another invader from the Neotropics, the "unvanquished" fire ant, *Solenopsis invicta* BUREN, 1974, began to spread around the world. *Solenopsis invicta* has displaced *S. geminata* in open and disturbed habitats in many parts of the southern US, leaving only remnant *S. geminata* populations, primarily in forested areas that *S. invicta* does not invade. Although *S. geminata* still has a much broader worldwide range, I expect *S. invicta* will continue to spread and displace *S. geminata* in open habitats through many other parts of the tropics and subtropics.

Key words: Biogeography, biological invasion, exotic species, invasive species, stinging ant.

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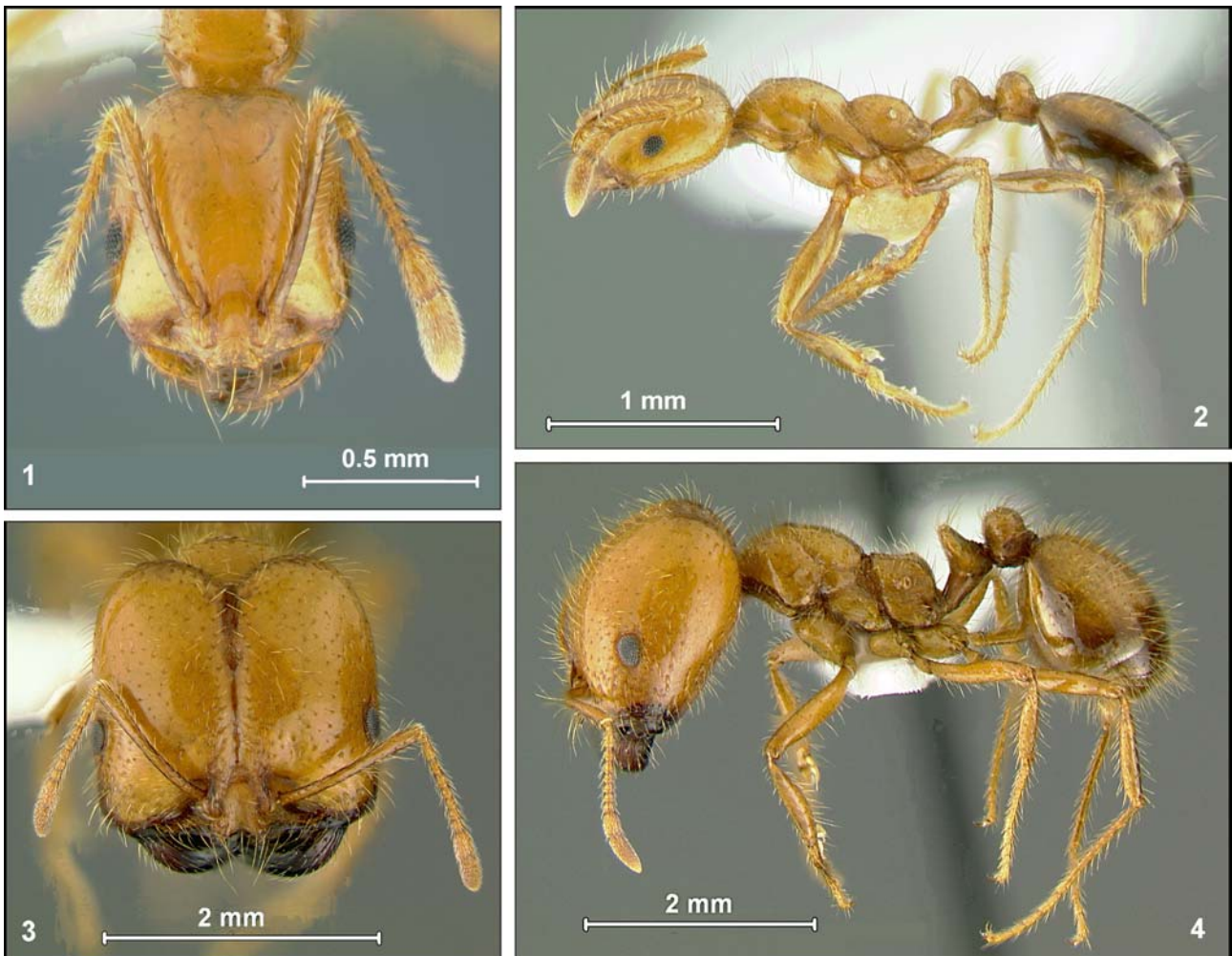
Introduction

The tropical fire ant, *Solenopsis geminata* (FABRICIUS, 1804) has long been one of the world's most dreaded ants due to its powerful sting, "which it uses on the slightest provocation" (WHEELER 1910). *Solenopsis geminata* is originally from the New World, where "its colonies are populous and so numerous that it may be said to be in possession of a large portion of the soil of the American tropics" (WHEELER 1910). Like many other "tramp" ants (e.g., *Paratrechina longicornis* (LATREILLE, 1802) and *Tapinoma melanoccephalum* (FABRICIUS, 1793); see WETTERER 2008, 2009), *S. geminata* has spread through human commerce to many other parts of the world.

Reports on *S. geminata* are replete with superlatives. WHEELER (1914) wrote that the behavior of *S. geminata* "exhibits a more bewildering diversity than that of any other known ant, for it is not only highly carnivorous, but attends scale insects and leaf hoppers for the sake of their saccharine excrement and even collects and stores seeds in its nests like a true harvesting ant. In Texas I have known it to sting

young chickens to death when they happened to be confined in a coop near its nest. In the same State it is helpful in destroying the boll weevil and other insects injurious to cotton, but is sometimes a pest in gardens when it takes to gnawing holes in strawberries." WHEELER (1910) wrote that *S. geminata* "attacks and eats almost everything that comes its way," and SMITH (1965) reported that *S. geminata* "is considered to be one of the most important predators of all the ants." *Solenopsis geminata* may be found in a wider range of habitats than any other fire ant species (TSCHINKEL 1988, 2006). For example, in Surinam, KEMPF (1961) reported *S. geminata* from gardens, fields, pastures, woodland, and primary forest. In addition, WHEELER (1922) called *S. geminata* "perhaps the most dreaded of the house ants."

In recent years, a new invader from the Neotropics, the "unvanquished" fire ant, *Solenopsis invicta* BUREN, 1974, has begun to spread around the world, displacing *S. geminata* both in the field and in the popular press. Nonetheless,



Figs. 1 - 4: *Solenopsis geminata*. (1) Head of minor worker from the Philippines; (2) lateral view of the same minor worker; (3) head of major worker from the Philippines; (4) lateral view of the same major worker (photos by G. Alpert).

S. geminata remains a dominant global pest. In the present study, I examine the worldwide spread of *S. geminata*.

Identification and taxonomy: *Solenopsis geminata* is a highly polymorphic species, with a wide range of worker size within a colony (head width = 0.55 - 2.30 mm; Figs. 1 - 4). *Solenopsis geminata* shows considerable variation in coloration. As a result of this variability, combined with some poor taxonomic work, *S. geminata* has been described repeatedly under many different names, now designated as junior synonyms. As CREIGHTON (1930) wrote: "*S. geminata*, the type of the genus, has been described a surprising number of times. There are no less than eleven names for this species which have been abandoned on the synonymic junk-heap." For example, in just one paper, BUCKLEY (1867), a geologist untrained in entomology, described *S. geminata* under three or more different names. WHEELER (1902) wrote that BUCKLEY'S (1867) "descriptions are, indeed, fearfully and wonderfully made. With a persistency, which at times seems almost intentional, the author selects for description the worthless, insignificant features of the ant's body."

Encouragingly, CREIGHTON (1930) and TRAGER (1991) made detailed taxonomic re-evaluations of *S. geminata* and its close relatives and their analyses largely agree on

the definition of *S. geminata*. CREIGHTON (1930) wrote: "It is inevitable that such a widely distributed and abundant ant should repeatedly appear in the literature under new names and it is remarkable that, despite this plethora of descriptions, the taxonomy of *geminata* has largely escaped confusion. At various times related species have been regarded as variants of *geminata* but, during the past sixty years there has been little doubt as to what constitutes the typical form. Truth compels one to add that this unusual situation is more a result of the characteristic cephalic structure of the major worker than an outcome of taxonomic acumen." Indeed, although *S. geminata* minors are very difficult to distinguish from minors of related fire ants, large *S. geminata* majors have several distinctive cephalic characteristics that make them simple to identify. These include: (1) a disproportionately large, almost square head with parallel sides, (2) a deep longitudinal groove on the front of the head extending from a distinct medial indentation in the vertex, (3) black mandibles, often with all teeth worn off from use, and (4) short antennal scapes extending only about halfway to the occiput in the largest majors (Figs. 3 - 4).

FABRICIUS (1804) described *Atta geminata* (= *S. geminata*) based on a queen from Central America. Taxa currently considered junior synonyms of *S. geminata* (with type

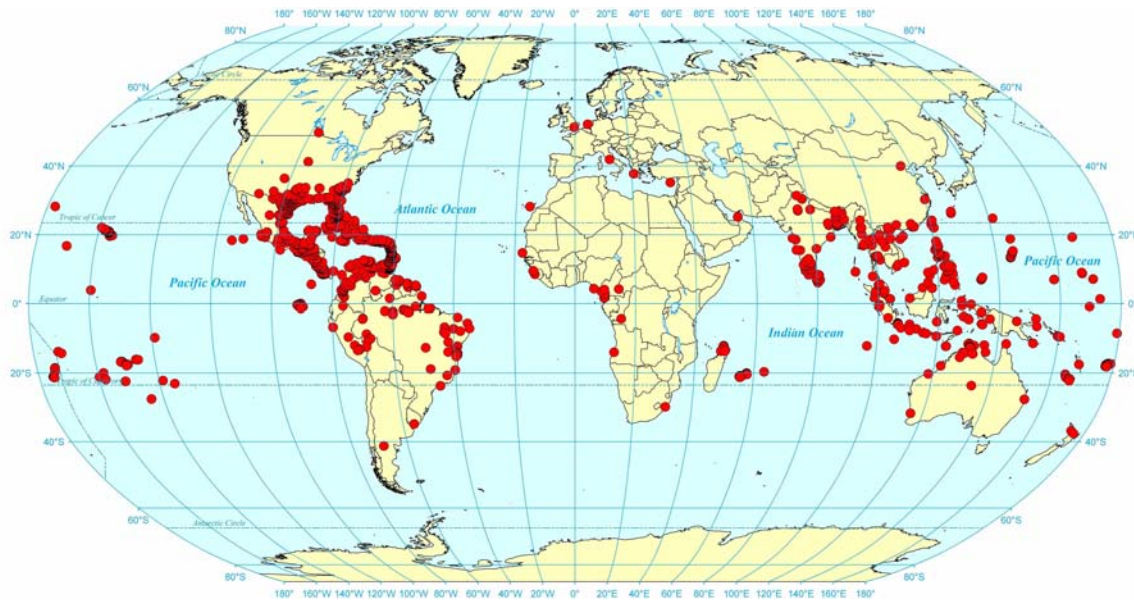


Fig. 5: Worldwide distribution records of *Solenopsis geminata*. In many areas, however, *S. geminata* populations have been greatly reduced or eliminated (see text).

locality in parentheses) include: *Myrmica paleata* LUND, 1831 (Brazil); *Solenopsis mandibularis* WESTWOOD, 1840 (Tropical America); *Atta rufa* JERDON, 1851 (India); *Atta clypeata* SMITH, 1858 (Mexico); *Solenopsis cephalotes* SMITH, 1859 (Aru Islands, Indonesia); *Myrmica mellea* SMITH, 1859 (Aru Islands); *Crematogaster laboriosus* SMITH, 1860 (Bacan, Indonesia); *Myrmica laevissima* SMITH, 1860 (Bacan); *Diplorhoptum drewseni* MAYR, 1861 (Italy); *Myrmica glaber* SMITH, 1862 (Panama); *Myrmica polita* SMITH, 1862 (Panama); *Atta coloradensis* BUCKLEY, 1867 (Texas); *Atta lincecumii* BUCKLEY, 1867 (Texas); *Myrmica saxicola* BUCKLEY, 1867 (Texas); *Solenopsis geminata diabola* WHEELER, 1908 (Texas); *Solenopsis geminata nigra* FOREL, 1908 (Costa Rica); *Solenopsis eduardi* FOREL, 1912 (Colombia); *Solenopsis geminata medusa* MANN, 1916 (Brazil); *Solenopsis geminata galapageia* WHEELER, 1919 (Galapagos); *Solenopsis eduardi bahiaensis* SANTSCHE, 1925 (Brazil and Venezuela); and *Solenopsis eduardi perversa* SANTSCHE, 1925 (Brazil). In addition, there is one remaining subspecies, *Solenopsis geminata micans* STITZ, 1912 (Seram Island, Indonesia); taxonomists need to evaluate whether this taxon deserves synonymy (see BOLTON 1995 for a taxonomic history of these names).

Some taxa were designated junior synonyms of *S. geminata*, but were later revived from synonymy, including: *Solenopsis gayi* (SPINOLA, 1851) (Chile; synonymized by MAYR 1886; revived by EMERY 1895); *Solenopsis saevissima* (SMITH, 1855) (Brazil; synonymized by MAYR 1865; revived by WHEELER 1915); *Solenopsis virulens* (SMITH, 1858) (Brazil; synonymized by MAYR 1886; revived by TRAGER 1991); and *Solenopsis xyloni* MCCOOK, 1880 (US; synonymized by MAYR 1886; revived by WHEELER 1910). GOETSCH (1933) synonymized *Aphaenogaster santiaguensis* GOETSCH, 1930 (Chile) with *S. geminata*, but I have been unable to find this taxon in any reference except GOETSCH (1930, 1933). Because SNELLING & HUNT (1975) recognized no records of *S. geminata* from Chile and con-

sidered published *S. geminata* records from Chile (MAYR 1865) to be misidentifications of *S. gayi*, it seems very likely that *A. santiaguensis* is a junior synonym of *S. gayi*. Although WHEELER (1902) and others speculated that *Atta brazoensis* BUCKLEY, 1867 (Texas) and *Myrmica sabeana* BUCKLEY, 1867 (Texas) were also junior synonyms of *S. geminata*, TRAGER (1991) conjectured that they were actually *S. xyloni*.

TRAGER (1991) and BOLTON (1995) considered *Solenopsis geminata innota* SANTSCHE, 1915 (described from Gabon, Liberia, and Zaire) to be a junior synonym of *S. geminata*, but other researchers disagree with this designation. COLLINGWOOD & VAN HARTEN (1993) reported *S. innota* from Cape Verde Islands off the coast of West Africa and stated "the enlarged petiole and postpetiole link it with *S. globularia*." In 2003, I collected ants in Cape Verde and found no *Solenopsis geminata*. Instead, at 78 sites on all nine inhabited islands, I collected a *Solenopsis* cf. *globularia*, a species with an enlarged petiole and post-petiole, apparently corresponding to *S. innota* (J.K. Wetterer & X. Espadaler, unpubl.). TAYLOR (2007) reported both *S. geminata* and *S. innota* from Cameroon. TAYLOR (2007) noted that the *S. innota* major had numerous characters distinguishing it from the *S. geminata* major, including several pronounced teeth on the mandible and longer scapes "almost attaining the occiput." I therefore consider *S. innota* to be a distinct taxon from *S. geminata*. One possibility is that some *S. innota* records are actually *Solenopsis virulens* (SMITH, 1858). This species, known from Brazil, Guyana, and Peru, is "yellow, monomorphic, and about the size of small majors of *S. saevissima* or *S. geminata*, but the postpetiole is subglobose and very large" (KEMPF & BROWN 1968).

A third fire ant taxon has been reported from Africa as well: *Solenopsis saevissima itinerans* (FOREL, 1911), described from Tanzania and later reported from Guinea (SANTSCHE 1914). FOREL (1911) described this taxon as "very similar to var. *Richteri* FOREL, but entirely brown.

The head is rather narrow, the nodes are also narrow and the hair is a little less abundant." It seems possible that these ants could be *S. saevissima*, *S. xyloni*, or *S. invicta*.

Some taxa have changed their taxonomic status relative to *S. geminata* many times. For example, FOREL (1904) described *Solenopsis geminata pylades* FOREL, 1904 (Mexico), but FOREL (1909) raised *S. pylades* to a full species. WHEELER (1915) considered it a junior synonym of *S. saevissima*, but FOREL (1916) again raised *S. pylades* to a full species and WHEELER (1919c) again considered it a junior synonym of *S. saevissima*. EMERY (1922) designated *S. pylades* a junior synonym of *S. geminata*, but SANTSCHI (1923) considered it a variety of *S. saevissima*. TRAGER (1991) designated *S. pylades* a junior synonym of *S. xyloni*, but PITTS (2002) made *S. pylades* a junior synonym of *S. saevissima*.

Previous accounts of the New World and worldwide distribution of *S. geminata*: There are many previous accounts describing the geographic range of *S. geminata* (e.g., FOREL 1899, CREIGHTON 1930, SMITH 1951, COMMONWEALTH INSTITUTE OF ENTOMOLOGY 1958, SMITH 1965, 1979, TRAGER 1991, TABER 2000, TSCHINKEL 2006). These accounts, however, vary considerably and are based on data of unknown detail and questionable accuracy.

FOREL (1899) wrote that *S. geminata* "is the most common species of tropical America, where it is not lacking, I think, on one square kilometer of lowland from Virginia south to the Argentine Republic." In 1899, however, *S. geminata* was considered the senior synonym of several other species, including *S. xyloni* in North America and *S. saevissima* and *S. virulens* in South America.

Using a revised, narrower concept of *S. geminata*, CREIGHTON (1930) wrote that its distribution "may be summarized as uniform throughout the West Indies and on the Continent from Florida to Costa Rica. In the eastern Gulf States its range extends inland only about a hundred to a hundred and fifty miles [160 - 240 km] and this also appears to be true for the greater part of Texas. From Mexico southward, however, the distribution is from coast to coast." CREIGHTON (1930) wrote that one color variant of *S. geminata* "extends northward from Peru through Ecuador and western Colombia into Central America and thence through Mexico to the Southern United States. That of the second group begins in Northeastern Colombia and passes through Venezuela, the Guianas and into eastern Brazil apparently terminating about the latitude of Bahia... Except for their greater variation in color and sculpture the members of the first group agree closely in structure with the insular [West Indian] *geminata*."

CREIGHTON (1950) wrote of *S. geminata*: "the main range of this insect lies in Central America and the Antilles. In the United States it occurs from Texas to South Carolina. The majority of these records come from areas on or near the coast. As one goes inland the incidence usually decreases except in Florida, where the insect seems to be uniformly distributed over the entire state."

SMITH (1951) wrote that *S. geminata* ranged "Fla. to Tex.; W. Indies, Mexico, Cent. Amer. and Pacific Coastal Plain through Columbia, Ecuador, and Peru," and *S. geminata rufa* ranged: "Fla. to Panama; also in Oriental and Australian Regions." SMITH (1965) wrote that *S. geminata* ranged "from Texas to South Carolina and Florida and south to at least Costa Rica. It also occurs in the West Indies." SMITH (1979) wrote that *S. geminata* ranged "S.C. s.

to Fla., w. to Tex. and s. to Peru; West Indies; tropical Asia and Pacific Islands."

The Commonwealth Agricultural Bureaux (COMMONWEALTH INSTITUTE OF ENTOMOLOGY 1958) published a map of the worldwide distribution of *S. geminata*. In the New World, *S. geminata* was shown ranging across the southern US from southern Virginia to southern California, through all of Mexico and Central America. In South America, the range of *S. geminata* was shown extending down the west coast to the Tropic of Capricorn in Chile, and down the east coast to São Paulo, except for a gap from southernmost Bahia to Rio de Janeiro. In the Old World, the map had *S. geminata* records scattered in Africa, Asia, Australia, and the Pacific. HILL (1974, 2008) reprinted this map unchanged.

TRAGER (1991) wrote that *S. geminata* range included the "coastal plain of the Carolinas and Georgia, Florida west to Texas, Central America, Antilles," and northern South America, "including the coastal areas of Northeastern Brazil, west through the Guianas to the Orinoco Basin, the western Amazon Basin and coastal areas of Peru." TRAGER (1991) wrote that in the Old World "*S. geminata* has been introduced into both tropical Asia and Africa. The first of these populations is now distributed from Taiwan and India in the North, throughout the Malay archipelago and Polynesia in the south, but the population is highly uniform throughout this vast range, with the light reddish coloration, relatively weak sculpture, and well-developed mesoplural process typical of the form *rufa*, and may result from the successful spread of a single original introduction." TRAGER (1991) wrote "the only population which might, in my opinion, be a distinct species among the material called *S. geminata* here is the western South American population of Colombia and Peru. This form averages smaller in all castes than *S. geminata* from elsewhere, and its sting is reputed to be more painful and to cause a pustule as do stings of the *S. saevissima* complex. The western population is apparently the source of the rather small *S. geminata* typical of the Galapagos Islands."

TABER (2000) included a map of the worldwide distribution of *S. geminata*. In the New World, the map showed a range that roughly followed the accounts of CREIGHTON (1930) and TRAGER (1991) with a few deviations: (1) greater inland penetration in the southeastern US (~ 400 km) with a continuous distribution from southern North Carolina across to Texas, (2) greater extension down the west coast of South America beyond Peru, extending ~ 500 km into Chile, (3) absence in western Mexico north of Acapulco, and (4) absence in the western Amazon basin. TABER (2000) also mapped scattered records of *S. geminata* in the Old World in rough agreement with TRAGER's (1991) general report, with most records spread between India and New Guinea, including large population records in Bangladesh, Malaysia, and New Guinea.

Most recently, TSCHINKEL (2006) included a map of the New World range of *S. geminata* that was similar to the range shown in TABER (2000), but with (1) only ~ 300 km inland penetration in the southeastern US from southern South Carolina to Texas, (2) only ~ 250 km extension into Chile, and (3) less extension into western Mexico.

Because few actual specimen records accompany all previously published reports on the range of *S. geminata*, it is unclear what is based on actual data and what is sup-

position. Here, I document in detail the known worldwide distribution of *S. geminata* based on specimen records.

Methods

Using published and unpublished records, I documented the worldwide range of *S. geminata*. I obtained unpublished site records from museum specimens in the collections of the Smithsonian Institution (SI; identified by M.R. Smith), Archbold Biological Station (ABS; identified by M. Deyrup), the British Natural History Museum (BMNH; identified by B. Bolton), the Museum of Comparative Zoology (MCZ; identified by S. Cover), and the Northern Territory Economic Insect Reference Collection (NTEIRC; provided by D. Chin). In addition, I used on-line databases with collection information on specimens by Antweb (www.antweb.org), the Chinese Ant Database (sciencenet/ant/english.html), the Essig Museum (essigdb.berkeley.edu), the Global Biodiversity Information Facility (www.gbif.org), and the Nebraska State Insect Records (nebreccs.unl.edu). I also received unpublished records from H. Axen (Belize, Brazil, Costa Rica, Dominican Republic, Florida, French Guiana, Galapagos, Guatemala, Honduras, India, Madagascar, Mascarene Islands, Mexico, Nicaragua, Texas, Trinidad, Turks & Caicos Islands, and Venezuela), M. DaSilva (Grenadine islands), B. Hoffmann (Australia), J. Latke (Venezuela), J. MacGown (Georgia, Mississippi), P.D. Rajan (India), and S. Sonthichai (Thailand). Finally, I collected *S. geminata* specimens in Central America, Florida, and on numerous Pacific and Caribbean Islands.

Geographic coordinates for collection sites came from published references, specimen labels, maps, or 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., STARR & al. 2007), I did not plot every site. I did not map records of *S. geminata* on boats, found in newly imported goods, or intercepted in transit by quarantine inspectors. Published records usually included collection dates. In a number of cases, publications did not include the collection dates for specimens, but I was able to determine the date based on information on the collector's travel dates or limit the date by the collector's date of death. For example, MAYR (1865) published *S. geminata* records collected by the Novara expedition, which visited Sri Lanka in 1858 and Tahiti in 1859. MAYR (1862) identified many specimens as *S. saevissima* that MAYR (1865) re-identified as *S. geminata*.

Through much of its worldwide range, *S. geminata* is the only fire ant known and thus records are likely to be reliable. In the New World, this includes all of Central America and (before 1981, when *S. invicta* was first recorded) the West Indies. In parts of the North and South America, other fire ants occur, including *S. amblychila* WHEELER, 1915, *S. aurea* WHEELER, 1906, and *S. xyloni* in the southern US and northern Mexico, and *S. gayi*, *S. invicta*, *S. saevissima*, and *S. virulens* in South America. Due to misidentifications and transitory synonymies, some specimen

records from these areas reported as *S. geminata* may actually be other *Solenopsis* species and vice versa. In addition, worker hybrids between *S. geminata* and *S. xyloni* (HUNG & VINSON 1977) further complicate taxonomy. To minimize the risk of identification errors, I did not map published *S. geminata* records predating CREIGHTON's (1930) revision from New World regions where other fire ant species occur, unless the records were confirmed in a post-1930 publication.

Results

I compiled published and unpublished specimen records from > 2100 sites worldwide (Fig. 5). I documented the earliest known *S. geminata* records for 122 geographic areas (countries, island groups, major Caribbean islands, and US states; Tabs. 1 - 6), including several areas for which I found no previously published records: Anguilla, Barbuda, Curaçao, Madagascar, Montserrat, Nebraska, Nevis, St Martin, and Vanuatu.

Unconfirmed New World records that I did not map included all published *S. geminata* records from Chile (e.g., MAYR 1862, 1865, BERG 1890, IHERING 1894), Paraguay (e.g., FOREL 1908), California (e.g., MAYR 1886, WHEELER 1908, ANDREWS 1916), and Virginia (e.g., FOREL 1899), as well as a subset of records from other areas, including Argentina (e.g., BAUR 1897, BRUCH 1914), Arizona (e.g., WHEELER 1908), Bolivia (e.g., EMERY 1894), Brazil (e.g., MAYR 1865, WASMANN 1890, 1896, IHERING 1894, FOREL 1907, 1908, MANN 1916), Mexico (e.g., ANDRÉ 1893, PERGANDE 1893, FOREL 1899, WHEELER 1901), New Mexico (e.g., TINSLEY 1898, CREIGHTON 1930), and North Carolina (e.g., WITHERS 1898, FOREL 1899). Although WHEELER (1908) described *S. geminata diabolica* (= *S. geminata*) from Texas, with additional records from Arizona, and California, I did not map the records from Arizona and California. KEMPF (1972) has the only post-1930 record of *S. geminata* from Bolivia, but with no site listed. Rather than mapping this record to the largest city, La Paz, in the cool highlands, I mapped this to Cobija in the northern lowlands, placing it nearest to records just across the border in Peru and Brazil. Although CREIGHTON (1930), SMITH (1951), and TRAGER (1991) all mention *S. geminata* in coastal Ecuador, and COMMONWEALTH INSTITUTE OF ENTOMOLOGY (1958), TABER (2000), and TSCHINKEL (2006) all mapped populations there, I found no site records for this region. I mapped no point in this region because I suspect that earlier authors may have simply inferred that *S. geminata* populations in coastal Colombia and coastal Peru were continuous through Ecuador.

I omitted CREIGHTON'S (1930) New Mexico record because CREIGHTON (1950) omitted it. I mapped only one post-1930 *S. geminata* record from New Mexico and one from Arizona. COLE (1953) reported "one colony of what I believe represents this species was nesting beneath a stone in very dry, level, stony soil 13 mi. N of Carlsbad, 3,300 ft," though this high elevation desert record seems very likely to be a misidentification. PLOWES & al. (2009) reported phorid flies that B. Brown collected 5 km E Portal, Arizona, attacking *S. geminata*; unfortunately, Brown (pers. comm.) could not locate any voucher ant specimens to verify this record.

In the case of several South American countries and US states (Tabs. 1 - 2), the earliest record was unconfirmed and

Tab. 1: Earliest known records for *Solenopsis geminata* from South and Central America and neighboring Pacific islands. Unpublished records include collector, museum source, and site. BMNH = Natural History Museum in London. * = earliest record unconfirmed and may be misidentification of another *Solenopsis* species.

	Earliest record
Central America	≤ 1804 (FABRICIUS 1804 – type locality)
Brazil	≤ 1831 (LUND 1831 as <i>M. paleata</i>)
Venezuela	1857 (H. Clark, BMNH): Tejuca
Mexico	≤ 1858 (SMITH 1858 as <i>A. clypeata</i>)
Panama	≤ 1861 (SMITH 1862 as <i>M. glaber</i> & <i>M. polita</i>)
Guyana	≤ 1862 (ROGER 1862*)
Uruguay	≤ 1862 (ROGER 1862*)
Surinam	≤ 1863 (ROGER 1863*)
French Guiana	1868 (RADOSZKOWSKY 1884*)
Nicaragua	≤ 1872 (T. Belt, BMNH): Chontales
Galapagos	1891 (EMERY 1893)
Bolivia	≤ 1894 (EMERY 1894*)
Cocos Islands	1898 (EMERY 1919)
Guatemala	1899 (Champion, BMNH): Guatemala City
Belize	1899 (FOREL 1900)
Colombia	≤ 1900 (FOREL 1900*)
Costa Rica	≤ 1900 (FOREL 1900)
Honduras	1920 (MANN 1922)
Ecuador	≤ 1930 (CREIGHTON 1930)
Peru	≤ 1930 (CREIGHTON 1930)
Islas Revillagigedo	≤ 1935 (WHEELER 1935)
El Salvador	≤ 1957 (BERRY & SALAZAR 1957)

not mapped, but many later records verified the presence of *S. geminata*. For example, MAYR (1886) published the earliest *S. geminata* records from Alabama, Florida, and Louisiana, and though these records were not confirmed, later records verified the presence of *S. geminata* in these states (e.g., CREIGHTON 1930).

For the Old World, I mapped all published records of *S. geminata*. However, I did not map African records originally identified as *S. innota* because these records appear to represent a distinct taxon: Cameroon (TAYLOR 2007), Cape Verde (COLLINGWOOD & VAN HARTEN 1993), Congo (Zaire) (SANTSCHI 1915), Gabon (SANTSCHI 1915), and Liberia (SANTSCHI 1913).

Tab. 2: Earliest known records for *Solenopsis geminata* from the USA and Canada. Abbreviations as in Tab. 1, and MCZ = Museum of Comparative Zoology. + = no known published record.

	Earliest record
Texas	≤ 1862 (ROGER 1862*)
Alabama	≤ 1886 (MAYR 1886*)
Florida	≤ 1886 (MAYR 1886*)
Louisiana	≤ 1886 (MAYR 1886*)
New Mexico	1897 (TINSLEY 1898*)
North Carolina	≤ 1899 (FOREL 1899*)
South Carolina	≤ 1899 (FOREL 1899*)
Georgia	≤ 1899 (FOREL 1899*)
Mississippi	≤ 1899 (FOREL 1899*)
Arkansas	≤ 1964 (WHITCOMB & BELL 1964 in WARREN & ROUSE 1969)
Manitoba	1977 (AYRE 1977)
+ Nebraska	1992 (D Ferraro, NIR): Omaha Zoo – Lied Jungle

Only 12 *S. geminata* site records came from latitudes at or above 35° (Fig. 5; five New World and seven Old World). The high latitude New World records are probably either introduced or misidentifications: the Tropical House of Assiniboine Park Zoo in Winnipeg, Canada (49.9° N; AYRE 1977), the Lied Jungle (billed as the "World's Largest Indoor Rainforest") at the Omaha Zoo (41.2° N; Tab. 2), Maquinchao, Argentina (~ 41° S; DONISTHORPE 1933), Sherman County, Texas (~ 36.3° N; O'KEEFE & al. 2000), and Uruguay (~ 35° S; BRANDÃO 1991). The high latitude Old World records are certainly all introduced: Netherlands (~ 52.3° N; BOER & VIERBERGEN 2008), Kew Gardens greenhouses, England (51.5° N; DONISTHORPE 1943), Italy (~ 42° N; MAYR 1861), Beijing, China (39.9° N; WHEELER 1927a), Zante Island, Greece (37.7° N; COLLINGWOOD 1993), Mount Maunganui, New Zealand (37.6° N; HARRIS 2005), and Cyprus (~ 35.2° N; COLLINGWOOD & al. 1997). Most or all of these high latitude populations of *S. geminata* have probably been eradicated or have died out.

Discussion

Worldwide distribution: In the New World, *Solenopsis geminata* has been reported from all South and Central American countries, the southern US from California to Virginia, and every island group in the West Indies. However, a number of these records were identified when then the definition of *S. geminata* included several other species. Thus, a number of unconfirmed records may be based on misidentification of these related species. Such likely misidentifications include all published *S. geminata* records from areas beyond the northern and southern ends of its confirmed range, including California, Virginia, and prob-

Tab. 3: Earliest known records for *Solenopsis geminata* from the West Indies. Abbreviations as in Tabs. 1 and 2.

	Earliest record
Cuba	≤ 1862 (ROGER 1862)
Puerto Rico	≤ 1863 (ROGER 1863)
Virgin Islands	1878 (FOREL 1881)
St Lucia	1889 (G.A. Ramge, BMNH): site unknown
St Vincent	≤ 1892 (FOREL 1893)
Jamaica	≤ 1893 (ANDRÉ 1893)
Barbados	1896 (FOREL 1912)
Grenada	≤ 1897 (FOREL 1897)
Bahamas	1904 (WHEELER 1905)
Haiti	≤ 1907 (FOREL 1907)
Guadeloupe	1911 (WHEELER 1913)
Dominica	1911 (WHEELER 1913)
Martinique	1911 (WHEELER 1913)
Trinidad	≤ 1915 (URICH 1915)
Tobago	1918 (WHEELER 1919a)
Antigua	1920 (WHEELER 1923)
Dominican Republic	≤ 1930 (MENOZZI & RUSSO 1930)
Bonaire	1936 (WEBER 1948)
Aruba	1936 (WEBER 1948)
St Kitts	1937 (WEBER 1948)
Statia	1937 (WEBER 1948)
+ Montserrat	1991 (J.P.E.C. Darlington, MCZ): Paradise Yard
Cayman Islands	≤ 2004 (VARNHAM 2006)
Turks & Caicos	≤ 2004 (VARNHAM 2006)
+ Curacao	2004 (J.K. Wetterer, MCZ): De Savaan
+ Anguilla	2006 (J.K. Wetterer, MCZ): Meads Bay
+ St Martin	2006 (J.K. Wetterer, MCZ): Pic Paradis
+ Barbuda	2007 (J.K. Wetterer, MCZ): Codrington
+ Nevis	2007 (J.K. Wetterer, MCZ): Cane Garden

ably Arizona and New Mexico in the north and Chile, Paraguay, and probably Argentina and Uruguay in the south.

My specimen record map for *S. geminata* (Fig. 5) in the New World differs from the range maps of COMMONWEALTH INSTITUTE OF ENTOMOLOGY (1958), TABER (2000),

Tab. 4: Earliest known records for *Solenopsis geminata* from Asia and neighboring islands. Abbreviation as in Tab. 1.

	Earliest record
India	≤ 1851 (JERDON 1851 as <i>S. geminata rufa</i>)
Sri Lanka	1858 (MAYR 1865)
Indonesia	≤ 1859 (SMITH 1859 as <i>S. cephalotes</i> & <i>M. mellea</i>)
Philippines	≤ 1862 (MAYR 1862 misidentified as <i>S. saevissima</i>)
Burma/Myanmar	1885 - 1887 (EMERY 1889)
Singapore	≤ 1897 (MAYR 1897)
Christmas Island	1915 (CRAWLEY 1915 as <i>S. geminata rufa</i>)
Malaysia	≤ 1919 (WHEELER 1919b as <i>S. geminata rufa</i>)
Laos	≤ 1920 (SANTSCHI 1920 as <i>S. geminata rufa</i>)
China	≤ 1927 (WHEELER 1927a as <i>S. geminata rufa</i>)
Vietnam	≤ 1927 (WHEELER 1927b as <i>S. geminata rufa</i>)
Hong Kong	≤ 1928 (WHEELER 1928)
Macao	≤ 1928 (WHEELER 1928)
Thailand	1928 (Hillman, BMNH): Bangkok
Papua New Guinea	≤ 1935 (WHEELER 1935 as <i>S. geminata rufa</i>)
Bangladesh	≤ 1958 (COMMONWEALTH INSTITUTE OF ENTOMOLOGY 1958)
Japan	1967 (KIRITANI & MORIMOTO 2004)
Taiwan	~ 1985 (CHEN & al. 2005)
UAE	1995 (COLLINGWOOD & al. 1997)
Hainan Island	1998 (FELLOWES & HAU 2001)
Brunei	1999 - 2000 (EGUCHI & YAMANE 2003)
Cocos (Keeling) Island	2005 (NEVILLE & al. 2008)

and TSCHINKEL (2006) in many respects. The COMMONWEALTH INSTITUTE OF ENTOMOLOGY (1958) map appears to approximate the combined range of *S. geminata*, *S. xyloxi*, *S. saevissima*, and *S. gayi*, no doubt due to misidentifications in the southwestern US and Mexico in the north and in Argentina, Brazil, and Chile in the south. The maps of TABER (2000) and TSCHINKEL (2006) omit published records from western Mexico north of Acapulco, e.g., CREIGHTON's (1930) record from Guadalajara, Jalisco. On the west coast of South America, I found *S. geminata* records extending only into northern Peru, in agreement with CREIGHTON (1930), SMITH (1979), and TRAGER (1991), not down into Chile as in TABER (2000) and TSCHINKEL (2006). Also, the TABER (2000) and TSCHINKEL (2006)

Tab. 5: Earliest known records for *Solenopsis geminata* from Oceania. Abbreviations as in Tabs. 1 and 2.

	Earliest record
Society Islands	1859 (MAYR 1865)
Australia	≤ 1863 (ROGER 1863)
New Zealand	≤ 1876 (MAYR 1876)
Hawaii	1879 (BLACKBURN & KIRBY 1880)
New Caledonia	≤ 1882 (EMERY 1883)
Mariana Islands	1894 (collector unknown, BMNH): Ladrone
Cook Islands	1914 (WILSON & TAYLOR 1967)
Samoa	1916 (H. Swale, BMNH): Apia
Tuamotu Islands	1925 (CHEESMAN & CRAWLEY 1928)
Austral Islands	1934 (WILSON & TAYLOR 1967)
Line Islands	1934 (WHEELER 1936)
Palau	1936 (CLOUSE 2007)
FSM	1950 (CLOUSE 2007)
Marshall Islands	1953 (CLOUSE 2007)
Tonga	1956 (WILSON & TAYLOR 1967)
Banaba	1957 (CLOUSE 2007)
Solomon Islands	1962 (GREENSLADE 1969)
Tuvalu	1976 (P. Maddison, BMNH): Funafuti
Gambier Islands	1996 (MORRISON 1997)
Marquesas Islands	1996 (MORRISON 1997)
Fiji	≤ 1997 (WATERHOUSE 1997)
Gilbert Islands	1999 (CLOUSE 2007)
+ Vanuatu	1999 (E. Tabi, MCZ): Sama

maps did not include records from Peru and Ecuador east of the Andes (e.g., PARDO VARGAS 1964, ESCALANTE-GUTIÉRREZ 1975, TOBIN 1995, PLOWES & al. 2009). In eastern South America, I found coastal records extended farther south than indicated by TABER (2000) and TSCHINKEL (2006), with many records not only throughout Bahia (e.g., FOWLER & DELABIE 1995, SANTOS & al. 1999, SANTANA-REIS & SANTOS 2001, PITTS 2002), but also farther south, in Espiritu Santo (PITTS 2002), Minas Gerais (FOWLER & al. 1995, NASCIMENTO 2005), and São Paulo (H. Axen, pers. comm.). TABER (2000) included a record from Rio de Janeiro, and though there are published records from here (MAYR 1865) and further south (IHERING 1894, FOREL 1908), I did not map these unconfirmed records because they are likely to be based on misidentifications.

Tab. 6: Earliest known records for *Solenopsis geminata* from Europe, Africa, and neighboring islands. Abbreviation as in Tab. 1.

Europe	Earliest record
Italy	≤ 1861 (MAYR 1861 as <i>D. drewseni</i>)
England	1932 (DONISTHORPE 1943)
Greece	1982 - 1988 (COLLINGWOOD 1993)
Cyprus	≤ 1997 (COLLINGWOOD & al. 1997)
Netherlands	1992 (BOER & VIERBERGEN 2008)
+ Africa	
Senegal	≤ 1862 (ROGER 1862)
Mascarene Islands	~ 1901 (D'EMMERZ DE CHARMOY 1921 in MOUTIA & MAMET 1946)
Congo Republic)	≤ 1909 (SANTSCHI 1909)
Sierra Leone	1915 (BACOT 1916)
Guinea	1935 (SANTSCHI 1939 as <i>S. geminata nigra</i>)
Equatorial Guinea	1939 - 1940 (MENOZZI 1942)
Nigeria	1969 (BOLTON 1973)
+ Madagascar	1981 (J.M. Wilson, BMNH): Ambilobe
South Africa	≤ 1990 (PRINS & al. 1990)
Canary Islands	1997 (HÖGMO 2003)
Cameroon	2001 (TAYLOR 2007)

In the Old World, *S. geminata* is widespread through tropical and subtropical Asia, Australia, and Oceania. The documented range of *S. geminata* in Africa is much more limited, and many *S. geminata* records from Africa appear to be a different species. Finally, there are a few indoor records from temperate Europe and North America. My new *S. geminata* distribution map (Fig. 5) includes many Old World records not found on TABER's (2000) map, e.g., England, Greece, Cyprus, Italy, Nigeria, Cameroon, Republic of Congo, Zaire, Vietnam, Burma, New Caledonia, Tuvalu, Solomon Islands, Fiji, Caroline Islands, Marshall Islands, and New Zealand. Many *S. geminata* records from Australia and New Zealand came from port areas and from plant nurseries, e.g., the Illparpa Nursery in Alice Springs (2005; NTEIRC). Control efforts in Australia and New Zealand have successfully exterminated numerous isolated local populations of *S. geminata* (B. Hoffmann, pers. comm.). In Australia, *S. geminata* populations are widespread only in the northern "Top End" region of Northern Territory.

Native versus exotic New World range: *Solenopsis geminata* is originally from the New World tropics and subtropics. However, the extent of the native range of *S. geminata* in the New World remains unclear. *Solenopsis geminata* is almost certainly native to South America, Central America, and Mexico, and most authors consider *S. geminata* as native to the southeastern US (e.g., WOJCIK

& al. 1976, JOUVENAZ & al. 1977, HÖLLDOBLER & WILSON 1990, TSCHINKEL 2006). SMITH (1930) listed *S. geminata* as an exotic in Florida, but later SMITH (1965) considered *S. geminata* to be a native species in the eastern US. TRAGER (1991) wrote: "*S. geminata* is apparently native to the southeast coastal plain and Florida to Texas ... south through Central America to Northern South America ... Populations of the Antilles and Galápagos (and possibly the Southeastern U.S.A.) are probably introduced, but have been in these areas for several centuries." DEYRUP & al. (2000) proposed that *S. geminata* in Florida might be a mix of native and exotic populations. In fact, this may be true in many other parts of the world as well.

In the southeastern US, populations of *S. geminata* appear to have more parasites than do populations of the exotic *Solenopsis invicta*, supporting the hypothesis that *S. geminata* is native to this region. For example, JOUVENAZ & al. (1977) surveyed *Solenopsis* parasites in the southeastern US, and found a 140 times higher rate of microsporidia infection in *S. geminata* colonies than in *S. invicta* colonies. In northern Florida, MCINNES & TSCHINKEL (1996) found mermithid nematode infection rate of 16% among *S. geminata* queens and 0% among *S. invicta* queens. In Florida, however, no parasitoid phorid flies naturally attack *S. geminata*, in contrast to Texas where 6 - 8 species of phorids attack *S. geminata* (S. Porter, pers. comm.), suggesting that *S. geminata* is not native to Florida.

Some authors have considered *S. geminata* as exotic to the West Indies. WHEELER (1908) reported *S. geminata* as "transported to the Antilles." TRAGER (1991) considered the West Indian populations as "probably introduced." Newly introduced species may show population explosions, so population explosions of *S. geminata* in the West Indies could indicate that this species is exotic to this region. WHEELER (1926) proposed that *Formica omnivora* LINNAEUS, 1758, a voracious ant that besieged several tropical West Indian islands in the 16th to 18th centuries, was most probably *S. geminata*. In summarizing early reports on *F. omnivora* in the West Indies, MORLEY (1953) was less circumspect concerning the identity of this pest: "In 1760 it was seriously debated whether the island of Barbados should be abandoned, because of the sudden and disastrous appearance of a plague of "Fire Ants," *Solenopsis geminata*. Their large aphids and scale insect herds did such damage to the sugar-cane crops that the island, formerly a flourishing colony, was driven to the verge of bankruptcy. The same ants appeared in Martinique in 1763, the year after its capture from the French by the British Admiral Rodney. Seven years later the island of Grenada, 170 miles to the south, suffered a similar fate." Population explosions of this ant, however, may have been related not to recent introduction, but instead to habitat changes associated with human settlement or to the introduction of a new mutualist aphid, scale insect, or other Hemiptera.

On-going research on the genetic diversity of *S. geminata* at sites around the world should help to resolve questions concerning the native range and invasion history of this species. For example, preliminary genetic results suggest that *S. geminata* populations in the southeastern US are exotic (AXEN 2008, H.J. Axen, pers. comm.). LONGINO (2005) noted that in Costa Rica, *S. geminata* has "a "red form" that is more abundant in open areas and a "black form" that prefers forested areas."

Community dominance: In many parts of its range, *S. geminata* is a dominant species in both natural and disturbed ecosystems, tending plant-feeding Hemiptera and acting as an important predator and seed-disperser (e.g., JEANNE 1979). For example, in Mexico, RISCH & CARROLL (1986) considered *S. geminata* to be a keystone species, because its presence or absence had a tremendous effect on both the arthropod community through predation and on the plant community through seed dispersal (RISCH & CARROLL 1986, HORVITZ & SCHEMSKE 1986). RISCH & CARROLL (1986) found that *S. geminata* in Mexico harvested small seeds and when common, *S. geminata* could reduce the abundance of many weedy plants, particularly grasses. In northeastern Mexico, FLORES-MALDONADO & al. (1999) found that *S. geminata* dominated disturbed oak and pine forests, making up the vast majority of ants collected in these habitats (91.7% and 96.2%, respectively). In Honduras, WYCKHUYS & O'NEIL (2007) found that *S. geminata* made up more than 50% of ants collected in subsistence maize fields.

Solenopsis geminata is also known to attack the hatchlings of birds & reptiles (e.g., STODDARD 1931, TRAVIS 1938, 1941, KROLL & al. 1973, MRAZEK 1974, MAES & MACKAY 1993). WETTERER (2006) found that *S. geminata* was the most common ant on an important sea turtle nesting beach in Tortuguero, Costa Rica, where earlier researchers documented ants preying on sea turtle eggs and hatchlings. *Solenopsis geminata* was the only species present that was likely to pose a significant threat to sea turtles. Because of the very high numbers of *S. geminata* on Tortuguero beach, the impact of these ants on hatchling sea turtles could be substantial, particularly on hatchlings stung as they exit their nests.

In agricultural areas, *S. geminata* may be a serious pest. For example, on Java and Mauritius, ORDELHEIDE (1929) and D'EMMEREZ DE CHARMOY (1930) reported *S. geminata* as a serious pest harvesting planted tobacco seeds. CHERIAN (1933) reported *S. geminata* destroying seedlings and burrowing into the roots of marijuana plants. STAHL & SCARAMUZZA (1929) reported *S. geminata* tending mealybugs on sugar.

In some cases, *S. geminata* is considered beneficial. For example, in Sri Lanka, ROTHNEY (1889) reported that *S. geminata* were deliberately introduced into warehouses to control termites. In Malaysia, SIVAPRAGASAM & CHUA (1997) found *S. geminata* was the major predator on cabbage pests.

Competition with other ants: *Solenopsis geminata* often shows a mutually exclusive distribution with other dominant ant species. For example, WHEELER (1910) reported this pattern with *S. geminata* and the African big-headed ant, *Pheidole megacephala* on two Caribbean islands: "I devoted ten days to a careful study of the ant-fauna of the little island of Culebra off the eastern coast of Porto Rico without seeing a single specimen of *Ph. megacephala*. This island is, however, completely overrun with a dark variety of the vicious fire-ant (*Solenopsis geminata*). One day, on visiting the island of Culebrita, which is separated by a shallow channel hardly a mile in width from the eastern coast of Culebra, I was astonished to find it completely overrun with *Ph. megacephala*. This ant was nesting under every stone and log, from the shifting sand of the sea-beach to the walls of the light-house on the highest point

of the island. The most careful search failed to reveal the presence of any other species, though the flora and physical conditions are the same as those of Culebra. It is highly probable that *Ph. megacephala*, perhaps accidentally introduced from the island of St. Thomas a few miles to the east, had exterminated all the other ants which must have previously inhabited Culebra. The absence of *megacephala* on Culebra is perhaps explained by the presence of the equally prolific and pugnacious fire-ant" (WHEELER 1910).

WETTERER & O'HARA (2002) found a similar pattern on the Dry Tortugas, the outermost Florida Keys. On Garden Key, *S. geminata* was the dominant ant, occurring at 70% of bait stations, usually with several hundred workers on each bait card. Many visitors on Garden Key reported being stung on the feet by these ants. Although *P. megacephala* may have occurred at one time on Garden Key, we found none. In contrast, we found no *S. geminata* on any other key in the Dry Tortugas. Instead, on Loggerhead Key and Bush Key, *P. megacephala* was the dominant ant.

In Laguna del Tigre National Park, BESTELMEYER & al. (2000) collected *S. geminata* in all surveyed areas, but "in the grassland transect, *Solenopsis geminata* was extremely dominant." In the grasslands, *Pheidole* sp. was the most common ant at tuna baits 10 and 30 min after placement. From 50 min on, however, *S. geminata* was the increasingly dominant species present and by 130 min, *Pheidole* sp. was completely displaced and no longer found at the baits.

***Solenopsis invicta* versus *Solenopsis geminata*:** In the 20th century, another *Solenopsis* fire ant has begun to spread around the world: *S. invicta*. This species has proven to be an even greater pest than *S. geminata*. For example, TSCHINKEL (2006) noted that the stings of *S. invicta* "have more severe and longer-term effects than those of *S. geminata*." Originally from South America, *S. invicta* arrived in Alabama by ship sometime before 1945 (BUREN & al. 1974). Since then, *S. invicta* has spread across the US from Texas to Virginia in the southeast and California in the west, causing widespread ecological and economic damage (WOJCIK & al. 2001). This dreaded ant is now spreading through the West Indies (WETTERER & DAVIS 2010) and has recently arrived in Asia (e.g., CHEN & al. 2005, ZHANG & al. 2007).

When it invades, *S. invicta* often displaces *S. geminata*, particularly in habitats preferred by both species: open, grassy areas. As a result, *S. geminata* has largely disappeared from much of its former range in the southeastern US (WOJCIK & al. 1976). For example, TSCHINKEL (2006) wrote that *S. geminata* "before *S. invicta* spread into Florida, was one of the most common ants there. It tolerated a wider range of habitats... including some types of woodland not preferred by *S. invicta*. As *S. invicta* spread, the two species occurred side by side for a while, but within a few years, *S. geminata* could be found only as enclaves in more wooded locations." In Florida, PORTER (1992) found *S. geminata* at 83% of roadside sites where *S. invicta* were absent, but only 7% of sites where *S. invicta* was present. Many climate models predict that *S. invicta* should be able to invade many additional regions in both the New World and Old World now occupied by *S. geminata* (e.g., see KORZUKHIN & al. 2001, MORRISON & al. 2004, SUTHERST & MAYWALD 2005). It seems likely that *Solenopsis geminata* is also excluded from many parts of South America by *S. invicta* and other resident fire ants.

With *S. invicta* receiving so much media attention, it appears that some recent reports in the popular press of *S. invicta* from parts of Asia (e.g., Malaysia, Singapore, Philippines) may actually be based on misidentifications of the long-resident *S. geminata*. In working to mitigate the negative impacts of *S. geminata*, *S. invicta*, and other fire ants around the world, it will be important to distinguish between these ants, and recognize both their similarities and their differences.

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Zusammenfassung

Die tropische Feuerameise, *Solenopsis geminata* (FABRICIUS, 1804), ist eine in vielen Teilen der Welt als Lästling und Schädling bekannte Art und wird wegen ihres schmerzhaften Stichs gefürchtet. Um die weltweite Verbreitung von *S. geminata* abzuschätzen, habe ich veröffentlichte und unveröffentlichte Nachweise von > 2100 Fundorten zusammengetragen. Ich dokumentiere die frühesten bekannten Nachweise der Art für 122 geographische Gebiete (Länder, Inselgruppen, große Karibische Inseln, US-Bundesstaaten und kanadische Provinzen), einschließlich einiger, für die ich keine bisher veröffentlichten Nachweise gefunden habe, beispielsweise Anguilla, Barbuda, Curaçao, Madagaskar, Montserrat, Nebraska, Nevis, St Martin und Vanuatu. Mehrere *Solenopsis*-Arten der Neuen Welt wurden früher als Juniorsynonyme von *S. geminata* betrachtet, z.B. *S. gayi* (SPINOLA, 1851), *S. saevissima* (SMITH, 1855), *S. virulens* (SMITH, 1858) und *S. xyloni* MCCOOK, 1880. Deshalb habe ich unbestätigte Meldungen von *S. geminata* von vor der Gattungsrevision von CREIGHTON (1930) für Regionen der Neuen Welt, in denen jene Arten vorkommen, nicht berücksichtigt – einige dieser frühen Meldungen basieren wahrscheinlich auf Fehlbestimmungen.

Zahlreiche Nachweise von *Solenopsis geminata* liegen für weite Teile der Tropen der Neuen Welt sowie auch für Teile des subtropischen Nordamerika vor. Die Art ist sicherlich in Süd- und Mittelamerika heimisch, aber könnte in den südöstlichen USA und den Westindischen Inseln exotisch sein, wobei die Einschleppung mehrere Jahrhunderte zurückliegen könnte. Bereits 1900 war die Art auch in vielen Teilen der Alten Welt verbreitet, einschließlich des tropischen Asiens und Ozeaniens.

In der Mitte des Zwanzigsten Jahrhunderts begann eine andere invasive Art aus den Neotropen, die "unbesiegt" Feuerameise, *Solenopsis invicta* BUREN, 1974, ihre globale Ausbreitung. *Solenopsis invicta* hat *S. geminata* in offenen und gestörten Habitaten in großen Teilen der südlichen USA ersetzt; Restpopulationen von *S. geminata* konnten vor allem in bewaldeten Gebieten überleben, die *S.*

invicta nicht besiedelt. Obwohl *S. geminata* derzeit noch eine weitaus größere globale Verbreitung hat, erwarte ich, dass *S. invicta* seine Ausbreitung fortsetzen und *S. geminata* in offenen Habitaten vieler Teile der Tropen und Subtropen ersetzen wird.

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