

Worldwide spread of Emma's dacetine ant, *Strumigenys emmae* (Hymenoptera: Formicidae)

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Abstract

Strumigenys emmae (EMERY, 1890) (Subfamily Myrmicinae, Tribe Dacetini) is a tiny predatory ant (total length ~ 1.7 mm) that feeds on minute soil arthropods. *Strumigenys emmae* has spread to many parts of the world through human commerce. However, because *S. emmae* workers are so small and slow moving, most people remain unaware of their presence. To examine the spread of *S. emmae*, I compiled specimen records from > 350 sites worldwide. I documented the earliest known *S. emmae* records for 64 geographic areas (countries, island groups, major Caribbean islands, and US states), including many areas for which I found no previously published records: Anguilla, Antigua, Aruba, Barbados, Barbuda, Bonaire, British Virgin Islands, Cape Verde, Cayman Islands, Comoro Islands, Grenada, Îles Éparses, Jamaica, Montserrat, Palau, St Kitts, St Lucia, Tobago, and Trinidad.

Strumigenys emmae appears to be originally from the Australian region, where all its closest relatives are found. *Strumigenys emmae* occurs primarily in tropical areas. Almost all subtropical records come from peninsular Florida, plus a few subtropical records from the Bahamas, Japan, and Australia. *Strumigenys emmae* is most commonly found in intact xeric and mesic forest, as well as in planted areas around buildings, but rarely occurs in moist habitats. There is little information available regarding any possible impact of *S. emmae* on the native mesofauna in its introduced range.

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

Myrmecol. News 16: 69-74 (online 4 November 2011)

ISSN 1994-4136 (print), ISSN 1997-3500 (online)

Received 15 February 2011; revision received 3 April 2011; accepted 4 April 2011

Subject Editor: Herbert Zettel

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Introduction

Numerous tramp ant species, spread by human commerce, have achieved broad cosmopolitan distributions. Several tramp ant species have become major ecological, agricultural, and / or household pests, e.g., *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) (WETTERER 2005, 2007, 2008, 2009a, b, WETTERER & al. 2009). Other tramp ants, though widespread, have remained inconspicuous, e.g., *Monomorium floricola* (JERDON, 1851), *Tetramorium bicarinatum* (NYLANDER, 1846), and *Tetramorium lanuginosum* MAYR, 1870 (WETTERER 2009c, 2010a, b). Among the most inconspicuous are the tramp dacetines (Subfamily Myrmicinae, Tribe Dacetini).

Dacetines are predatory ants that generally feed on springtails (Collembola) and other tiny soil arthropods (WILSON 1953). Dacetines are small, cryptically colored, and slow moving, and they become motionless when disturbed. As a result, most people, including field biologists, remain unaware of their presence even in areas where they are common. For example, CARROLL (2009) surveyed 15 bayhead tree-islands in the Florida Everglades and did not find any dacetines in visual searches, yet found them in

Berlese extractions of leaf litter from 14 of the 15 islands.

BOLTON (2000) recognized 872 dacetine species. Of these, only three have achieved broad distributions in both the Old World and the New World: *Strumigenys rogeri* (EMERY, 1890), *Strumigenys membranifera* EMERY, 1869, and *Strumigenys emmae* (EMERY, 1890). The workers of these three species differ in size (*S. rogeri* = 2.3 - 2.8 mm total length, *S. membranifera* = 1.9 - 2.1 mm, *S. emmae* = 1.5 - 1.9 mm). The mandibles are long and linear in *S. rogeri*, triangular in *S. membranifera*, and sickle-shaped in *S. emmae* (Figs. 1 - 4). WETTERER (2011, 2012) examined the worldwide spread of *S. rogeri* and *S. membranifera*. Here, I take a closer look at the smallest of the three cosmopolitan dacetine ants, *S. emmae*.

EMERY (1890) named this species after Emma Forel, wife of the eminent Swiss myrmecologist Auguste-Henri Forel. DEYRUP (1997) called *Strumigenys emmae* by the common name "Emma's bowed-jaw snap-trap ant", and DEYRUP & al. (2000) called *S. emmae* the "bow-jawed pygmy snapping ant." I have used a simpler common name, "Emma's dacetine ant."

Taxonomy and geographic origin

EMERY (1890) described *Epitritus emmae* (= *Strumigenys emmae*) from St Thomas, US Virgin Islands. Junior syno-



Figs. 1 - 4: *Strumigenys emmae*. (1) Head of a worker from Santa Cruz Island, Galapagos; (2) lateral view of the same worker; (3) dorsal view of the same worker; (4) worker at Archbold Biological Station, Florida (1 - 3 by A. Nobile, courtesy antweb.org; 4 by A. Wild).

nymms of *S. emmae* include *Epitritus clypeatus* SZABÓ, 1909 from New Guinea and Singapore, *Epitritus clypeatus malesiana* FOREL, 1913 from Sumatra, and *Epitritus wheeleri* DONISTHORPE, 1916 from Hawaii.

BROWN (1949) placed *Strumigenys emmae* in the new genus *Quadristruma* with one other species, *Quadristruma eurycera* (EMERY, 1897) (= *Strumigenys eurycera*), known only from New Guinea. BARONI-URBANI & DE ANDRADE (1994) made *Quadristruma* a junior synonym of *Strumigenys*. BOLTON (2000) placed *S. emmae* in the "emmae-group" along with six newly described *Strumigenys* species all known only from Australia and placed *S. eurycera* in the "eurycera-group" along with three newly described species known only from New Guinea and neighboring islands. Based on the distribution of its closest relatives, BOLTON (2000) concluded that *S. emmae* originated in the Australian region.

Materials and methods

Using published and unpublished records, I documented the worldwide range of *Strumigenys emmae*. I obtained unpublished site records from museum specimens in the col-

lections of Archbold Biological Station (ABS, identified by M. Deyrup), the Museum of Comparative Zoology (MCZ, identified by S. Cover), and the Smithsonian Institution (SI, identified by B. Bolton). In addition, I used on-line databases with collection information on specimens by the Essig Museum of Entomology at the University of California, Berkeley (UCB), Antweb (www.antweb.org), and the Global Biodiversity Information Facility (www.gbif.org). I received unpublished records from J. Delabie (Brazil) and J. Czekanski-Moir (Palau). Finally, I collected *S. emmae* specimens on islands of the Pacific, Atlantic, and West Indies.

I obtained geo-coordinates for collection sites from published references, specimen labels, maps, or geography web sites (e.g., earth.google.com, www.tageo.com, and www.fallingrain.com). If a site record listed a geographic region rather than a "point locale", and I had no other record for this region, I used the coordinates of the largest town within the region or, in the case of small islands and natural areas, the center of the region. I did not map records of *Strumigenys emmae* found in newly imported goods or intercepted in transit by quarantine inspectors. Pub-

Tab. 1: Earliest known records for *Strumigenys emmae* from the Indo-Pacific. Unpublished records include collector, museum source, and site. + = no previously published records. MCZ = Museum of Comparative Zoology.

	Earliest record
Papua New Guinea	≤ 1897 (EMERY 1897)
Singapore	≤ 1909 (SZABÓ 1909 as <i>E. clypeatus</i>)
Indonesia	1911 - 1912 (FOREL 1913 as <i>E. clypeatus malesiana</i>)
Hawaii	≤ 1916 (DONISTHORPE 1916 as <i>E. wheeleri</i>)
Mariana Islands	1945 (BROWN 1949)
Philippines	1945 (J.W. Chapman, MCZ): Dumaguete
Malaysia	1946 (BOLTON 1983)
FS Micronesia	1950 (CLOUSE 2007)
Vanuatu	1955 (E.O. Wilson, MCZ): 8 km SW Luganville
Samoa	1956 (WILSON & TAYLOR 1967)
Australia	1958 (Darlingtons, MCZ): Tozer Gap
Solomon Islands	1963 (BOLTON 2000)
Japan	1975 (M. Shindo, MCZ): Chichi-jima
Tonga	≤ 1980 (DLUSSKY 1993)
India	≤ 1983 (BOLTON 1983)
Taiwan	1987 (TERAYAMA & KUBOTA 1989)
Tuamotu Islands	1987 (PERRAULT 1993)
Society Islands	1991 (L. Morrison, MCZ): Tiahura
New Caledonia	1995 (JOURDAN & CHAZEAU 1997)
Hong Kong	≤ 1996 (FELLOWES 1996)
Vietnam	≤ 2000 (BOLTON 2000)
Cocos (Keeling) Islands	2005 (NEVILLE & al. 2008)
Christmas Island	2004 - 2005 (FRAMENAU & THOMAS 2008)
+ Palau	2007 (J. Czekanski-Moir, pers. comm.): Ngaremlengui

lished 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 approximate date based on information on the collector's travel dates or limit the date by the collector's date of death, e.g., BOLTON (1983) listed an undated specimen record from Equatorial Guinea collected by L. Fea, who collected there in 1899 - 1900 and died in 1900.

Tab. 2: Earliest known records for *Strumigenys emmae* from Africa, the Arabian Peninsula, and neighboring islands. CAS = California Academy of Sciences. Other abbreviations as in Table 1.

	Earliest record
Equatorial Guinea	1899 - 1900 (BOLTON 1983)
Ghana	1969 (BOLTON 1973)
Seychelle Islands	1975 (MÜHLENBERG & al. 1977)
Madagascar	≤ 2000 (BOLTON 2000)
Mascarene Islands	2001 (BLARD & al. 2003)
Yemen	2002 (COLLINGWOOD & VAN HARTEN 2005)
Ascension	2003 (WETTERER & al. 2007a)
+ Cape Verde	2003 (J.K. Wetterer, MCZ): Mindelo
+ Îles Éparses	2007 (B.L. Fisher & al., CAS): Com-bani, Mayotte
+ Comoro Islands	2009 (B.L. Fisher & al., CAS): Mohéli

Results

I compiled *Strumigenys emmae* specimen records from > 350 sites worldwide (Fig. 5). I documented the earliest known *S. emmae* records for 64 geographic areas (countries, island groups, major Caribbean islands, and US states; Tabs. 1 - 4), including many locales for which I found no previously published records: Anguilla, Antigua, Aruba, Barbados, Barbuda, Bonaire, British Virgin Islands, Cape Verde, Cayman Islands, Comoro Islands, Grenada, Îles Éparses, Jamaica, Montserrat, Palau, St Kitts, St Lucia, Tobago, and Trinidad.

In the Pacific (1995), I collected *Strumigenys emmae* at just one site in Tonga, in a visual survey: Lifuka (Niu'akalo, under coconut logs by beach).

In the Atlantic (2003), I collected *Strumigenys emmae* from litter with a Davis sifter at four sites on three islands of Cape Verde. All four sites were flower gardens: Fogo (São Filipe, bank garden), Santo Antão (Ponto do Sol, town center garden), São Vicente (Mindelo, hotel garden; Mindelo, Palacio do Pouo garden).

In the West Indies (2003 - 2010), I collected *Strumigenys emmae* from litter with a Davis sifter at 49 sites on 23 islands, in a variety of habitats: Anguilla (Maunday's Bay, beach sea grape; Winward Point Bay, beach sea grape), Antigua (Old Road, mango / bananas), Barbados (Black Rock, by apartments; Marine Gardens, by apartments; pool, forest), Barbuda (northern highlands, scrub), Bonaire (Fontein, under planted trees), Grand Cayman (Botanic Park, scrub), Grenada (Hope Estate, forest; Petit Bacaye, wooded yard; river Antoine, cane field), Guadeloupe (Deshaies, botanical garden; Pelletan, scrub; St Claude, by park office), Jamaica (Montego Bay, by Grace Hotel; Montego Freeport, by yacht club), Mona (Sardinera, by pier; Pajaros Beach, beach; SW Pajaros, pier & beach), Montserrat (Jack Boy Hill, forest; Trant's Bay, forest), Nevis (Cane Garden, ghut forest; Golden Rock, nature trail forest),

Tab. 3: Earliest known records for *Strumigenys emmae* from the West Indies. INHS = Illinois Natural History Survey. SI = Smithsonian Institution. Other abbreviations as in Table 1.

	Earliest record
US Virgin Islands	≤ 1890 (EMERY 1890)
St Vincent	≤ 1893 (FOREL 1893)
Cuba	≤ 1913 (WHEELER 1913)
Bahamas	1918 (MANN 1920)
Puerto Rico	1935 - 1936 (SMITH 1936)
+ Jamaica	1950 (W.L. Brown, INHS): Kingston, Hope Gardens
+ British Virgin Islands	1968 (G. Talla, SI): Tortola
Guadeloupe	1987 (JAFJE & al. 1991)
Dominican Republic	1992 (BOLTON 2000)
+ Tobago	2003 (J.K. Wetterer, MCZ): Forest Reserve
+ Trinidad	2003 (J.K. Wetterer, MCZ): Victoria Mayaro Reserve
+ Barbados	2003 (J.K. Wetterer, MCZ): Pool
+ Anguilla	2006 (J.K. Wetterer, MCZ): Winward Point Bay
+ Grenada	2006 (J.K. Wetterer, MCZ): River Antoine
+ St Lucia	2006 (J.K. Wetterer, MCZ): Gros Islet
+ Antigua	2007 (J.K. Wetterer, MCZ): Old Road
+ Aruba	2007 (J.K. Wetterer, MCZ): Bubali
+ Barbuda	2007 (J.K. Wetterer, MCZ): North Highlands
+ Montserrat	2007 (J.K. Wetterer, MCZ): Jack Boy Hill
+ St Kitts	2007 (J.K. Wetterer, MCZ): Brimstone Hill
+ Bonaire	2008 (J.K. Wetterer, MCZ): Fontein
+ Cayman Islands	2008 (J.K. Wetterer, MCZ): Grand Cayman Botanic Park

Puerto Rico (Punta Vacía Talega, beachfront), St Croix (Frederiksted, waterfront urban park; Little Fountain, forest; Morning Star, trees planted by road; Queen's Quarters, under planted trees; Prosperity, forest; St George, botanical garden), St John (Cinnamon Bay, beach sea grape; Haulover, beach scrub; Hawksnest Bay, beach forest), St Kitts (Brimstone Hill, forest; Great Salt Pond, scrub; Stone Fort, acacia), St Lucia (Cap Estate, by golf course; Gros Islet,

Tab. 4: Earliest known records for *Strumigenys emmae* from South, Central, and North America.

	Earliest record
Florida	1945 (DEYRUP & DEYRUP 1999)
Surinam	≤ 1949 (BROWN 1949)
Galapagos	1992 (PEZZATTI & al. 1998)
Brazil	1992 (MAJER & DELABIE 1994)
Costa Rica	1996 (MATLOCK & DE LA CRUZ 2003)
Belize	1997 (BOLTON 2000)
Panama	1998 - 1999 (STUNTZ 2001)
Venezuela	≤ 2001 (OJASTI 2001)

by hotel), St Thomas (Botany Bay, forest; Botany Bay, estate entrance; Nadir, forest; University of the Virgin Islands, forest), St Vincent (Rabacca, scrub; Wallilabou Falls, forest), Tobago (Forest Reserve, forest), Tortola (Brewers Bay, beach forest), Trinidad (Victoria Mayaro Reserve, forest), and Vieques (Playa Media Luna, beach sea grape).

Discussion

Strumigenys emmae is a primarily tropical species (Fig. 5). Records of *S. emmae* are particularly widespread from the tropical islands of the West Indies and Indo-Pacific. Almost all subtropical records come from peninsular Florida, plus a few records from the Bahamas (MANN 1920, DEYRUP 1997), the southern Japanese islands (Ogasawara, Daitō, and Okinawa Islands: SHINDO 1979, JAPANESE ANT IMAGE DATABASE 2003), and Australia (DLUSSKY 1994, BOLTON 2000). Outside of peninsular Florida, there are few continental records of *S. emmae*, including just one record from continental Africa (Ghana: BOLTON 1973).

In my surveys, I encountered *Strumigenys emmae* in a wide variety of habitats, typically finding one or two specimens in sifted litter samples. This species, however, may be fairly common in many areas, but generally overlooked because it is very small, even compared to other dacetine ants. DEYRUP & DEYRUP (1999) extracted litter samples from a wide variety of habitats around Florida and found *S. emmae* in 227 of 908 (25%) of all samples. DEYRUP & DEYRUP (1999) reported *S. emmae* from sites in 28 counties of Florida, most commonly from intact xeric and mesic forest and tropical hardwood hammock, as well as in planted areas near buildings, but rarely in moist habitats. In contrast, DEYRUP & al. (2000) reported that in Florida, *S. membranifera* is generally found in open area such as pastures and lawns, and *S. rogeri* is most common in moist habitats.

Strumigenys emmae has very small colonies. DEYRUP & DEYRUP (1999) reported finding two *S. emmae* colonies in Florida, both inside hollow acorns. The colonies each had one queen and brood, plus 14 and 42 workers, respectively. Unless one is specifically looking for them, the likelihood of finding a colony of *S. emmae* may be very low, even in areas where they are common.

Strumigenys emmae appears to have similar food habits as the two other cosmopolitan dacetine ants, *S. membranifera*

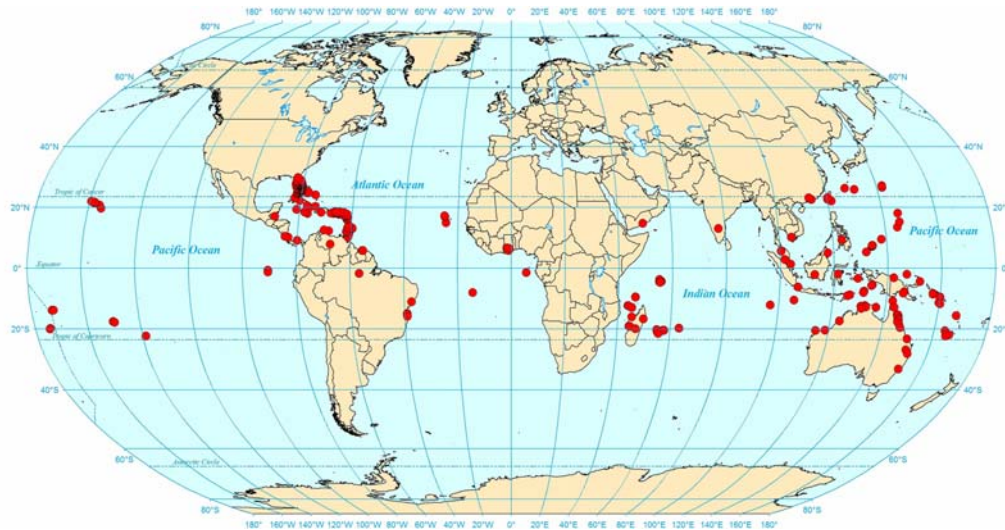


Fig. 5: Worldwide distribution records of *Strumigenys emmae*.

fera and *S. rogeri*, preying on tiny soil arthropods. Differences in body size and mandible morphology among these three species may be related to differences in the size and type of prey attacked by each species.

Although just three dacetine species (*Strumigenys emmae*, *S. membranifera*, and *S. rogeri*) have widespread distributions in both the Old World and the New World, several other dacetines have also spread to exotic locales via human commerce. For example, *Strumigenys hexamera* (BROWN, 1958), originally from East Asia, has begun to spread in the southeast US, with records from Florida, Louisiana, and Mississippi (DEYRUP 1988, BOLTON 2000, MACGOWN & al. 2005). The South American *Strumigenys silvestrii* EMERY, 1906 has not only spread to sites outside its native range within the New World, such as the Bahamas, Cuba, Dominican Republic, California, Florida, and Louisiana (BOLTON 2000), but has recently been recorded in the Old World, from two sites on the island of Madeira, off the Northwest coast of Africa (WETTERER & al. 2007b).

DEYRUP & DEYRUP (1999) emphasized that there is no evidence that exotic populations of *Strumigenys emmae* in Florida are having any significant impact on native species. Nonetheless, DEYRUP & al. (2000) classified *S. emmae* to be a "possible ecological villain" in Florida. In fact, the ecological importance of these tiny, inconspicuous invaders, as well as that of all other dacetine ants, remains largely unstudied.

Acknowledgements

I thank M. Wetterer for comments on this manuscript; S. Cover for help, encouragement, and ant identification; J. Delabie and J. Czekanski-Moier for providing unpublished records; S. Cover (MCZ) and M. Deyrup (ABS) for help with their respective ant collections; W. O'Brien for GIS help; D.P. Wojcik and S.D. Porter for compiling their valuable FORMIS bibliography; R. Pasos and W. Howerton of the FAU library for processing so many interlibrary loans; Florida Atlantic University and the National Science Foundation (DES-0515648) for financial support.

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