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Worldwide spread of Roger's dacetine ant, *Strumigenys rogeri* (Hymenoptera: Formicidae)

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Abstract

Strumigenys rogeri EMERY, 1890 (Subfamily Myrmicinae, Tribe Dacetini) is a very small ant (total length ~ 2.5 mm) that nests in and under dead wood and preys on tiny soil arthropods. *Strumigenys rogeri* has spread to many parts of the world through human commerce. However, because *S. rogeri* workers are so small and slow moving, and they become motionless when disturbed, most people, including field biologists, remain unaware of their presence. To examine the spread of *S. rogeri*, I compiled specimen records from > 400 sites worldwide. I documented the earliest known *S. rogeri* records for 67 geographic areas (countries, island groups, major Caribbean islands, US states, and Canadian provinces), including many areas for which I found no previously published records: Antigua, Austral Islands, Barbados, British Virgin Islands, Comoro Islands, Grenada, Guadeloupe, Îles Éparses, Martinique, Nevis, Palau, Philippines, St Kitts, St Lucia, St Martin, and Tanzania.

Strumigenys rogeri apparently originated in tropical Africa, where its closest relatives all live, but it has become widespread on tropical islands of the Indo-Pacific and the West Indies, and in peninsular Florida. Outside of Africa and Florida, there are only a small number of continental records of *S. rogeri*, including a few from South and Central America and just one from continental Asia, in peninsular Malaysia. It is unclear whether *S. rogeri* has not yet spread to these continental areas, whether continental ants have competitively excluded *S. rogeri*, or whether these ants have been simply overlooked in surveys of diverse continental faunae. There is little information on what impact *S. rogeri* may be having on the native mesofauna in its exotic range.

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

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Introduction

Dacetines (Subfamily Myrmicinae, Tribe Dacetini) are predatory ants that generally feed on springtails (Collembola) and other tiny soil arthropods (WILSON 1953). BOLTON (2000) recognized 872 dacetine species. Three dacetines have achieved broad distributions in both the Old World and the New World, spread through human commerce: *Strumigenys rogeri* EMERY, 1890, *Strumigenys emmae* (EMERY, 1890), and *Strumigenys membranifera* EMERY, 1869. The workers of these three species differ greatly 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), as well as morphology. The mandibles are long and linear in *S. rogeri*, sickle-shaped in *S. emmae*, and triangular in *S. membranifera*. Because dacetines rarely forage openly above ground, are small, cryptically colored, slow moving, and they become motionless when disturbed, most people, including field biologists, remain unaware of their presence. WETTERER (2011) examined the worldwide spread of *S. membranifera*. Here, I consider *S. rogeri* (Figs. 1 - 4).

Strumigenys rogeri nests in and under dead wood (BROWN 1954). *Strumigenys rogeri* workers have long, toothed mandibles that quickly snap shut, impaling encountered prey. GRONENBERG (1996) found "in *Strumigenys* sp., the strike takes less than 2.5ms. It is released within 5ms by contact of trigger hairs on the labrum. The ants employ a catapult mechanism to generate such a fast movement. Before the strike, the mandibles are opened wide and locked in the open position by the labrum, which functions as a latch. They stay open even when the large slow closer muscles contract. Upon trigger hair stimulation, the labrum is pulled backwards by a small, fast trigger muscle. The mandibles are thus freed from the catch and close rapidly." Although *S. rogeri* is tiny, its impact on other tiny soil arthropods could be substantial. Often predators can act as "keystone species," where their presence or absence can greatly influence the make up of the community. Unfortunately, the almost microscopic organisms that make up the soil mesofaunal community remain largely undescribed in most parts of the world.

Taxonomy and geographic origin

EMERY (1890) recognized that ROGER (1862) had described *Strumigenys gundlachi* from Cuba based on the workers of one species and the queen of another. EMERY (1890) separated the two species, giving the queen's species a new name, *Strumigenys rogeri*. Junior synonyms of *S. rogeri*

Figs. 1 - 4: *Strumigenys rogeri*. (1) Head of a worker from Mauritius; (2) lateral view of the same worker; (3) dorsal view of the same worker; (4) worker in Florida (photos 1 - 3 by A. Nobile courtesy antweb.org; photo 4 by A. Wild).

include *Strumigenys incisa* GODFREY, 1907 (described from a greenhouse in Scotland; synonymized by DONISTHORPE 1915) and *Strumigenys sulfurea* SANTSCHI, 1915 (described from Gabon; synonymized by BROWN 1954).

The earliest published outdoor records of *S. rogeri* all came from Caribbean islands (Tab. 2) leading DONISTHORPE (1908, 1915, 1927) to consider *S. rogeri* to be a West Indian species. BROWN (1954), however, concluded: "there can be little doubt of the origin of *S. rogeri* in Africa. It has no close relatives in the New World endemic fauna, and it is clearly very close to *S. rufobrunea*, *S. londianensis* and other African species, previous accounts to the contrary notwithstanding." African specimens of *S. rogeri* vary in color from reddish brown to yellowish orange (see TAYLOR 2008). Outside Africa, all *S. rogeri* specimens are orange. BROWN (1954) wrote: "The extra-African material, as would be expected of a tramp species stemming from a single female, or at least a restricted-locality stock, is unusually uniform."

BROWN (1962) wrote that *S. rogeri* "is a tramp belonging to a characteristically African species-group, and itself probably West African in origin." BOLTON (1983) also considered *S. rogeri* as "probably of West African origin." BOLTON (2000) placed *S. rogeri* in the "*rogeri*-group" along with 25 other species, all known only from Africa and Madagascar. The sole member of the *S. rogeri*-group found outside this region is *S. rogeri*. BOLTON (2000) wrote: "members of the *rogeri*-group are instantly diagnosed by the presence of a deep preocular notch in the ventrolateral margin of the head that detaches the anterior portion of the eye from the side of the head." Within the *S. rogeri*-group, BOLTON (2000) placed *S. rogeri* in the "*rogeri*-complex" along with two newly described species known only from tropical West Africa: *Strumigenys bernardi* BROWN, 1960 (known from Zaire, Cameroon, Equatorial Guinea, and Gabon) and *Strumigenys vazerka* BOLTON, 1983 (known from Ivory Coast and Ghana).

Although most researchers use no common name for *S. rogeri*, DEYRUP (1997) referred to this species as "Roger's African long-jawed snap-trap ant," and DEYRUP & al. (2000) used the name "Roger's pygmy snapping ant." I have used the name "Roger's dacetine ant" as a simpler alternative for the only dacetine named after the German entomologist Julius Roger.

Materials and methods

Using published and unpublished records, I documented the worldwide range of *S. rogeri*. I obtained unpublished site records from museum specimens in the collections 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 J. Wetterer). 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

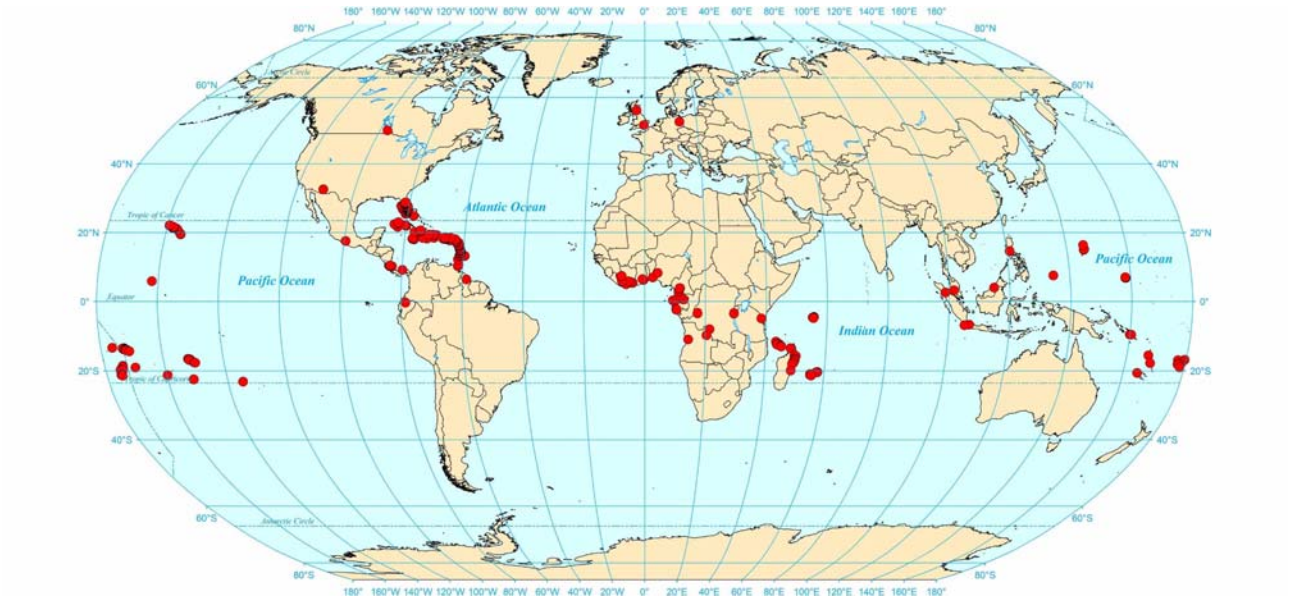

Fig. 5: Worldwide distribution records of *Strumigenys rogeri.*

Biodiversity Information Facility (www.gbif.org). I also received unpublished records from G.M. Dlussky (Samoa). Finally, I collected *S. rogeri* specimens on numerous Pacific and Caribbean Islands.

I obtained geographic 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 *S. rogeri* 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 approximate date based on information on the collector's travel dates or limit the date by the collector's date of death.

Results

I compiled *S. rogeri* specimen records from > 400 sites worldwide (Fig. 5). I documented the earliest known *S. rogeri* records for 67 geographic areas (countries, island groups, major Caribbean islands, US states, and Canadian provinces; Tabs. 1 - 4), including many locales for which I found no previously published records: Antigua, Austral Islands, Barbados, British Virgin Islands, Comoro Islands, Grenada, Guadeloupe, Îles Éparses, Martinique, Nevis, Palau, Philippines, St Kitts, St Lucia, St Martin, and Tanzania.

JANDA & al. (2008) listed *S. rogeri* from New Guinea, but when I sought the collection information, M. Janda (pers. comm.) told me this record was an error.

Almost all outdoors records of *S. rogeri* are tropical. Subtropical outdoors records are known only from peninsular Florida and the Bahamas, and all outdoors records from latitudes greater than 25° come from peninsular Florida, with a northernmost record from Wekiwa Springs State Park (28.77° N; ABS; FDEP 2005).

Tab. 1: Earliest known records of *Strumigenys rogeri* from Africa and neighboring islands. + = no previously published records. MCZ = Museum of Comparative Zoology, CAS = California Academy of Sciences.

	Earliest record
Gabon	≤ 1915 (SANTSCHI 1915 as *S. sulfurea*)
Ivory Coast	1963 (L. Brader, MCZ): Divo
Angola	1964 (L. de Carvalho, MCZ): Cossa
Seychelles	≤ 1982 (BATHE 1982 in HILL & al. 2002)
Burundi	≤ 1983 (BOLTON 1983)
Ghana	≤ 1983 (BOLTON 1983)
Cameroun	≤ 1983 (BOLTON 1983)
Nigeria	≤ 1983 (BOLTON 1983)
Zaire	1985 (BOLTON 2000)
Mascarene Islands	1989 (BOLTON 2000)
Madagascar	1992 (BOLTON 2000)
Benin	≤ 2000 (BOLTON 2000)
+ Tanzania	2002 (V. Grebennikov, TAYLOR 2008): Grant's Lodge
+ Îles Éparses	2007 (B. Fisher & al., CAS): Mont Combani
+ Comoro Islands	2008 (B. Fisher & al., CAS): Grillé, Grande Comore

There are only five records of *S. rogeri* from latitudes greater than 29°, all come from inside greenhouses: at the Royal Botanic Garden in Scotland (55.95° N; GODFREY 1907), in Germany (~ 52° N; EICHLER 1952), at Kew Gar-

Tab. 2: Earliest known records of *Strumigenys rogeri* from the West Indian islands. MCZ = Museum of Comparative Zoology.

	Earliest record
Cuba	≤ 1862 (ROGER 1862 as *S. gundlachi*)
US Virgin Is	≤ 1890 (EMERY 1890)
St Vincent	≤ 1893 (FOREL 1893)
Puerto Rico	1906 (WHEELER 1908)
Haiti	1912 - 1913 (WHEELER & MANN 1914)
Dominican Rep.	≤ 1930 (MENOZZI & RUSSO 1930)
Montserrat	1935 (WEBER 1952)
Dominica	1935 (N.A. Weber, MCZ): no site
Jamaica	1950 (BROWN 1954)
Trinidad	≤ 1954 (BROWN 1954)
Bahamas	1996 (DEYRUP 1997)
+ Barbados	1998 (S. Cover & E.O. Wilson, MCZ): Hackleton's Cliff
+ St Lucia	2003 (J.K. Wetterer, MCZ): Barre de l'Isle
+ British Virgin Is	2005 (J.K. Wetterer, MCZ): Sabbath Hill
+ Grenada	2006 (J.K. Wetterer, MCZ): Tufton Hall
+ St Martin	2006 (J.K. Wetterer, MCZ): La Colombe
+ Antigua	2007 (J.K. Wetterer, MCZ): Fig Tree Hill
+ St Kitts	2007 (J.K. Wetterer, MCZ): Jack-in-the-Box
+ Nevis	2007 (J.K. Wetterer, MCZ): Tower Hill
+ Guadeloupe	2008 (J.K. Wetterer, MCZ): Gosier
+ Martinique	2008 (J.K. Wetterer, MCZ): Anse Couleuvre

dens in England (51.47° N; DONISTHORPE 1908), at Assiniboine Park Tropic House in Manitoba (49.88° N; AYRE 1977), and at Biosphere 2 in Arizona (32.58° N; WETTERER & al. 1999).

Discussion

Strumigenys rogeri apparently originated in tropical West Africa; its closest relatives are known only from this region. Records of *S. rogeri* come from many parts of sub-Saharan Africa and neighboring islands (Tab. 1; Fig. 5), and it is now also widespread on tropical islands of the Indo-Pacific and the West Indies, and in peninsular Florida (Fig. 5). Peninsular Florida is ecologically similar to a subtropical island because it is not connected to any other subtropical landmass. The only record of *S. rogeri* from the continental US outside of Florida is a single specimen WETTERER & al. (1999) extracted from soil inside Biosphere 2, an enormous greenhouse structure built in the

Tab. 3: Earliest known records of *Strumigenys rogeri* from Indo-Pacific islands. MCZ = Museum of Comparative Zoology, CAS = California Academy of Sciences, UCB = University of California at Berkeley.

	Earliest record
Hawaii	1933 (WILSON & TAYLOR 1967)
Fiji	≤ 1948 (BROWN 1948)
Palmyra	1948 (CLOUSE 2007)
Society Islands	1949 (WILSON & TAYLOR 1967)
FS Micronesia	≤ 1954 (BROWN 1954)
Samoa	1956 (WILSON & TAYLOR 1967)
Vanuatu	1962 (L. Weatherhill, MCZ): Santo
Wallis & Futuna	1965 (WILSON & HUNT 1967)
Indonesia	1968 (H. Imoi, MCZ): Bogor
Cook Islands	≤ 1979 (WALKER & DEITZ 1979)
Tonga	≤ 1980 (DLUSSKY 1993)
Solomon Islands	≤ 1983 (BOLTON 1983)
Mariana Islands	≤ 1994 (TERAYAMA & al. 1994)
Niue	1996 (COLLINGWOOD & VAN HARTEN 2001)
Gambier Islands	1996 (MORRISON 1997)
New Caledonia	≤ 2000 (BOLTON 2000)
+ Austral Islands	2006 (P.D. Krushelnycky, UCB): Rurutu
+ Palau	2007 (A.R. Olsen & J. Czekanski-Moir, CAS): Ngaremlengui
+ Philippines	≤ 2010 (ALPERT & al. 2010)

Arizona desert. All outdoors records of *S. rogeri* from latitudes greater than 25° come from peninsular Florida. Except perhaps southernmost Texas, the rest of the continental US may be too cool for outdoor populations of *S. rogeri*.

Outside of Africa and Florida, there are only a few continental records of *S. rogeri* including a small number of records from South and Central America and just one from continental Asia, from peninsular Malaysia (Fig. 5). It is unclear whether *S. rogeri* has not yet spread to these continental areas, whether other ants have competitively excluded *S. rogeri*, or whether researchers in these areas have simply overlooked or not recognized the presence of this species.

CLOUSE (1999) called *S. rogeri* "an aggressive invader" in Florida where he observed it "in high densities along marshy trails on the Eastern Florida coast." DEYRUP & al. (2000) considered *S. rogeri* to be a "possible ecological villain" in Florida. DEYRUP & al. (2000) wrote that *S. rogeri* "is the common dacetine in bayheads, baygalls, and other swamp forest habitats in south and central Florida. Samples collected by Walter Suter between 1960 and 1970 suggest

Tab. 4: Earliest known records of *Strumigenys rogeri* from other regions. MCZ = Museum of Comparative Zoology, SI = Smithsonian Institution.

	Earliest record
Non-African continental	
Guyana	1935 (N.A. Weber, MCZ): Rio Mazaruni Forest Settlement
Florida	1965 (DEYRUP & al. 2000)
Mexico	1966 (N.L.H. Krauss, SI): Chilpancingo
Ecuador	1975 (S. & J. Peck, MCZ): Santo Domingo
Costa Rica	1980 - 1981 (YOUNG 1983)
Panama	≤ 1983 (BOLTON 1983)
Malaysia	≤ 1983 (BOLTON 1983)
Temperate greenhouses	
Scotland	1904 (GODFREY 1907 as *S. incisa*)
England	1907 (DONISTHORPE 1908)
Germany	≤ 1939 (EICHLER 1952)
Manitoba	1977 (AYRE 1977)
Arizona	1997 (WETTERER & al. 1999)

that several species of *Smithistruma* [now *Strumigenys*], as well as *Strumigenys louisianae*, were much more common in the absence of *S. rogeri* than they are today, although our survey methods may not replicate Suter's, and there have been many other changes in Florida since 1970. Since this species is apparently moving northward, it might be useful to do some intensive sampling ahead of its advance."

Unlike many tramp ant species that are able to invade only disturbed habitats, *S. rogeri* is able to penetrate into native habitats inconspicuously. LONGINO (1997) wrote that in Costa Rica, "at La Selva Biological Station, *rogeri* occurs in leaf litter deep within mature rainforest. Thus, it appears to be one of the few exotics that can invade mature forest, rather than being restricted to synanthropic habitats." CARROLL (2009) surveyed 15 bayhead tree-islands in Loxahatchee National Wildlife Refuge in the Florida Everglades and did not collect *S. rogeri* in any visual searches, but found this species in Berlese extractions on 14 of the 15 islands. I expect that researchers in many parts of the world may collect *S. rogeri* in forest surveys but mistake it to be an unknown native *Strumigenys* species. This problem, however, can be easily remedied because, outside of Africa, *S. rogeri* is very simple to identify.

Strumigenys rogeri appears to have similar food habits as the two other tramp dacetine ants, *S. membranifera* and *S. emmae*, preying on tiny soil arthropods, such as Collembola. These three dacetine species, however, have different habitat preferences. For example, in Florida, *S. rogeri* is most common in moister areas and found even in relatively pristine environments. In contrast, *S. membranifera* "often occurs in open area such as pastures and lawns," and *S. emmae* occurs in "dry and mesic woods, and in disturbed areas such as gardens" (DEYRUP & al. 2000). The ecological importance of these dacetine invaders, as well as that of many other inconspicuous tramp ants, e.g., *Monomorium floricola* (JERDON, 1851) and *Tetramorium lanuginosum* MAYR, 1870 (see WETTERER 2010a, b), remains largely unstudied.

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