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Worldwide distribution of *Syllophopsis sechellensis* (Hymenoptera: Formicidae)

James K. Wetterer[1,] and Mostafa R. Sharaf[2]*

Abstract

Syllophopsis sechellensis (Emery) (formerly *Monomorium sechellense*) (Hymenoptera: Formicidae) is a small, inconspicuous ant species, native to the Old World tropics, but has spread by human commerce to other parts of the world. The extent of its original native range is unclear. Here, we examined the worldwide distribution of *S. sechellensis*, particularly its spread to the New World. We compiled published and unpublished *S. sechellensis* specimen records from >160 sites. We documented the earliest known *S. sechellensis* records for 43 geographic areas (countries, island groups, and West Indian islands), including many islands for which we found no previously published records, in Southeast Asia (Singapore), the Indian Ocean (Comoro Islands, Îles Éparses, Mascarene Islands), Pacific Ocean (Palau), Atlantic Ocean (Cape Verde Islands), and the Caribbean (Guadeloupe, Grenada, Martinique, Mona, Puerto Rico, St. Croix, St. Lucia, St. Martin, St. Thomas, St. Vincent, and Trinidad). The geographic ranges of *S. sechellensis* and other *Syllophopsis* species suggest that *S. sechellensis* may be native to Madagascar and neighboring islands in the western Indian Ocean or to Southeast Asia or both. The earliest known record of *S. sechellensis* in the New World was collected in Barbados in 2003. We recorded this species on 11 additional West Indian islands. This finding might indicate that *S. sechellensis* is rapidly spreading through the West Indies. Alternatively, it may be that this inconspicuous ant has simply been overlooked or misidentified in this region.

Key Words: biogeography; biological invasion; exotic species; invasive species; island fauna

Resumen

Syllophopsis sechellensis (Emery) (anteriormente *Monomorium sechellense*) (Hymenoptera: Formicidae) es una pequeña especie de hormiga inconspicua, nativa de los trópicos del Mundo Antiguo, pero se ha extendido por el comercio humano a otras partes del mundo. La extensión de su área nativa original no está clara. Aquí, examinamos la distribución mundial de *S. sechellensis*, en particular su disperción al Nuevo Mundo. Recopilamos registros de especimenes de *S. sechellensis* publicados y no publicados de > 160 sitios. Se documentaron los primeros registros conocidos de *S. sechellensis* para 43 áreas geográficas (países, grupos de islas y islas de las Indias Occidentales), incluyendo muchas islas para las cuales no se encontraron registros publicados previamente en el sudeste asiático (Singapur), el Océano Índico , Îles Éparses, Islas Mascarene), Océano Pacífico (Palau), Océano Atlántico (Cabo Verde) y el Caribe (Guadalupe, Granada, Martinica, Mona, Puerto Rico, Santa Cruz, Santa Lucía, Tomás, San Vicente y Trinidad). El rango geográfico de *S. sechellensis* y otras especies de *Syllophopsis* sugieren que *S. sechellensis* puede ser nativa de Madagascar y de las islas vecinas del Océano Índico occidental o del sudeste asiático o de ambas. El primer registro conocido de *S. sechellensis* en el Nuevo Mundo fue recogido en Barbados en 2003. Se registró esta especie en otras 11 islas de las Indias Occidentales. Este hallazgo podría indicar que *S. sechellensis* se está extendiendo rápidamente a través de las Indias Occidentales. Alternativamente, puede ser que esta hormiga inconspicuo simplemente haya sido pasada por alto o mal identificada en esta región.

Palabras Clave: biogeografía; invasión biológica; especies exoticas; especies invasivas; fauna de la isla

Syllophopsis (Hymenoptera: Formicidae) is a genus of small, inconspicuous ants, with 21 described species (Bolton 2016). Most *Syllophopsis* species are known only from the Afrotropical bioregion. One *Syllophopsis* species, however, has achieved broad distribution through multiple bioregions: *S. sechellensis* (Emery). Here, we examined the worldwide distribution of *S. sechellensis*, and evaluated where it may be native and where it has recently spread through human commerce.

Santschi (1915) described *Syllophopsis* as a subgenus of *Monomorium*. Some subsequent authors followed this designation, whereas others considered *Syllophopsis* to be a distinct genus. Most recently, Ward et al. (2014) revised the genus *Monomorium* and confirmed *Syllophopsis* as a distinct genus.

Syllophopsis workers are small, monomorphic, yellow to light brown in color, and have 12-segmented antennae with 3-segmented terminal clubs (Bolton 1987). *Syllophopsis* species resemble small *Solenopsis* thief ants. However, the 2 genera can be distinguished easily because *Solenopsis* workers have 2-segmented terminal clubs.

Of the 21 recognized species of *Syllophopsis*, 17 species are known only from the greater Afrotropical region: Africa, Madagascar, the Arabian Peninsula, and western Indian Ocean islands: *S. adiastolon* (Heterick), *S. aureorugosa* (Heterick), *S. cryptobia* (Santschi), *S. dentata* (Sharaf), *S. elgonensis* Santschi, *S. ferodens* (Heterick), *S. fisheri* (Heterick), *S. gongromos* (Heterick), *S. hildebrandti* (Forel), *S. infusca* (Heterick). *S. jonesi* (Arnold), *S. kondratieffi* (Sharaf & Aldawood), *S. malamixta* (Bolton), *S. modesta* (Santschi), *S. saudiensis* Aldawood, *S. sersalata* (Bolton), and *S. thrascolepta* (Bolton). In addition, 3 *Syllophopsis* species are known solely from outside the Afrotropical bioregion: *S. subcoeca* (Emery) (from the Neotropics), *S. australica* (Forel)

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(from Australasia, Indomalaya, and Oceania), and *S. vitiensis* (Mann) (from Fiji). Only *S. sechellensis* has been widely reported both from islands of the western Indian Ocean islands and from other parts of the world.

Emery (1894a) described *Monomorium fossulatum sechellense* (= *S. sechellensis*) from the Seychelles before Emery (1895) described the nominal subspecies of *M. fossulatum* from Burma. When Wilson & Taylor (1967) synonymized the 2 subspecies, they designated *M. fossulatum* as the senior synonym. However, based on the publication dates of the 2 names, Bolton (1995) designated *M. sechellense* as the senior synonym.

Like most *Syllophopsis* species, *S. sechellensis* has tiny eyes. One character, however, that distinguishes *S. sechellensis* from other members of the genus is that its entire mesopleuron is matte and reticulate punctate, whereas in all other described *Syllophopsis* species the mesopleuron is glossy and smooth.

Materials and Methods

Using published and unpublished records, we documented the worldwide range of *S. sechellensis.* We obtained unpublished site records from museum specimens in the collection of the Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ). In addition, we used online databases with collection information on specimens by AntWeb (www.antweb.org). We excluded records where identifications were recorded as uncertain, e.g., Onoyama (1976) reported "*M. fossulatum* (?)" from Okinawa, Japan.

We obtained geographic coordinates for collection sites from published references, specimen labels, maps, or geography websites (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 we had no other record for this region, we 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. We did not map records of *S. sechellensis* on boats, found in newly imported goods, or intercepted in transit by quarantine inspectors.

Published records usually included collection dates. In some cases, records did not include the collection dates for specimens, but we were able to determine or approximate the date based on information from museum specimens, on the collector's travel dates, or limit the date by the collector's date of death. We categorized each site record as belonging to 1 of 7 terrestrial bioregions (following Olson et al. 2001): Afrotropics, Palearctic, Indomalaya, Australasia, Oceania, Nearctic, and Neotropics.

Results

We compiled published and unpublished *S. sechellensis* specimen records from >160 sites (Fig. 1). We documented the earliest known *S. sechellensis* records for 43 geographic areas (countries, island groups, and West Indian islands), including many islands for which we found no previously published records, in the Indian Ocean (Comoro Islands, Îles Éparses, Mascarene Islands), Pacific (Palau), Atlantic (Cape Verde), and Caribbean (Guadeloupe, Grenada, Martinique, Mona, Puerto Rico, St. Croix, St. Lucia, St. Martin, St. Thomas, St. Vincent, and Trinidad) (Tables 1 and 2).

Records ranged in latitude from Blackall Range near Maleny, Queensland, Australia (26.8°S; Nakamura 2007) in the south to Tokyo, Japan (35.7°N; Schmidt 2010) in the north. The Tokyo record, however, is much further north than the next highest latitude record, on Amamioshima, Japan (28.3°N; Fukumoto et al. 2016), and therefore deserves confirmation. The geographic areas with the most sites records were Fiji (27), Hawaii (20), Madagascar (12), the Seychelles (12), and the Mascarene Islands (11).

J. K. W. collected *S. sechellensis* at the following 21 sites on 16 islands, including 3 on Pacific islands, 1 in Southeast Asia, 1 on an Atlantic island, and 16 on West Indian islands, and M. S. confirmed identifications (arranged from south to north, collection date and geographic coordinates in parentheses):

Tonga, 'Eua, eastern slope forest (23 Aug 1995, 21.375°S, 174.915°W)

American Samoa, Tutuila, Mapusaga, yard (16 Jun 1995; 14.324°S, 170.744°W)

American Samoa, Tutuila, Mapusaga, forest (18 Jul 1995; 14.322°S, 170.744°W)

Singapore, Katong, Amber Road, woods (28 Jul 2014; 01.299°N, 103.900°E)

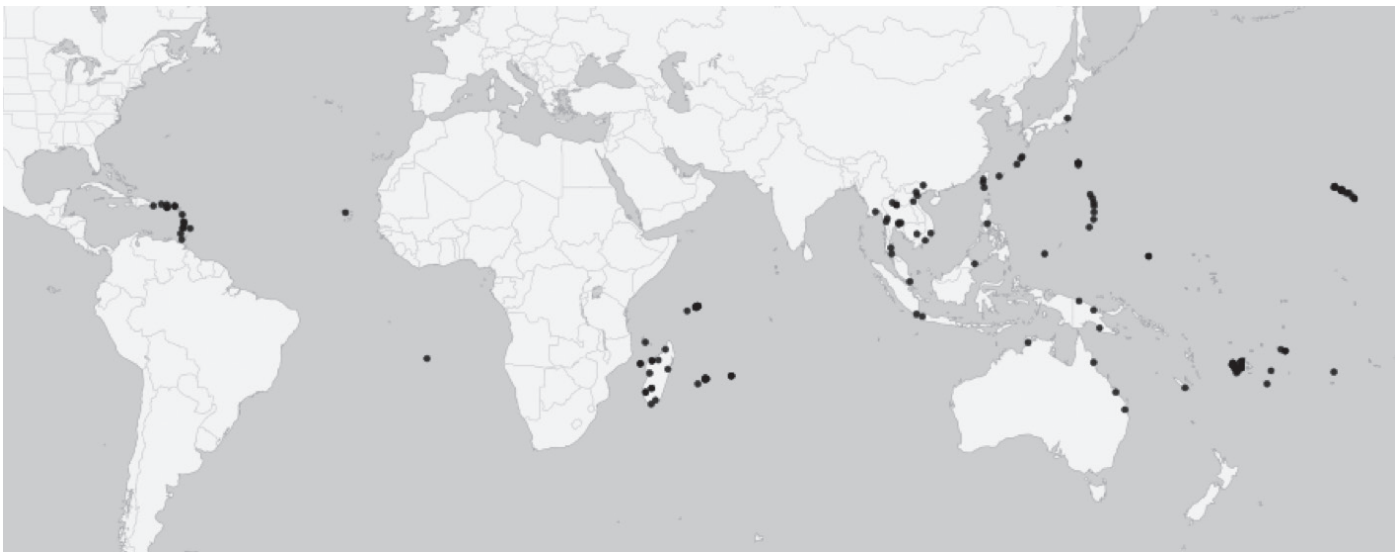


Fig. 1. Worldwide distribution records of *Syllophopsis sechellensis.*

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Table 1. Earliest known records for *Syllophopsis sechellensis* in Old World bioregions.

Region	Location	Earliest record
Afrotropics	Seychelles	1892 (Emery 1894a)
	Mascarene Islands[a]	≤1900 (O. Staudinger, MCZ): Réunion
	Madagascar	1993 (Heterick 2006)
	Saint Helena	1994–1995 (Wetterer et al. 2007 as *M*. cf. *sechellense*)
	Cape Verde[a]	2003 (J. K. Wetterer): Ribeira Brava, São Nicolau
	Comoros[a]	2009 (B. L. Fisher et al., antweb): Lac Boundouni, Mohéli
	Îles Éparses[a]	2011 (B. L. Fisher, antweb): Juan de Nova
Indomalaya	Burma	1887 (Emery 1895 as *M. fossulatum*)
	Taiwan	≤1912 (Forel 1912 as *M. fossulatum*)
	Ogasawara Islands	≤1979 (Shindo 1979 in Onoyama 1980 as *M. fossulatum*)
	Nansei Islands	1991–1993 (Yamauchi & Ogata 1995 as *M. fossulatum*)
	Philippines	≤1998 (Way et al. 1998 as *M. seychellense*)
	Malaysia	1998 (Hashimoto et al. 1999)
	Vietnam	2001 (Yamane et al. 2002)
	Thailand	2002 (Waanthogchai & Hasin 2002)
	Indonesia	1999–2003 (Ohkawara & Akino 2005 as *M. fossulatum*)
	China	≤2004 (Zhou & Pan 2004)
	Cambodia	2010 (Hosoishi et al. 2013)
	Singapore[a]	2014 (J. K. Wetterer): Katong
Australasia	Papua New Guinea	≤1900 (Emery 1900 as *M. fossulatum papuasiae*)
	Australia	1979 (G. B. Monteith, antweb): Yeppoon
	New Caledonia	1994 (Jourdan 2006)
Oceania	Hawaii	1916 (Timberlake 1925 as *M. fossulatum seychellense*)
	Samoa	1940 (Wilson & Taylor 1967 as *M. fossulatum*)
	Mariana Islands	1945 (Clouse 2007)
	FS Micronesia	1953 (Clouse 2007)
	Fiji	1976 (Ward & Wetterer 2006)
	Tonga	1980 (Dlussky 1994 as *M. fossulatum*)
	Cook Islands	1996 (Morrison 1997)
	Palau[a]	2007 (A. R. Olsen & J. E. Czekanski-Moir, antweb): Ngaremlengu
Palearctic	Japan	≤2009 (Schmidt 2010)

[a]No previously published records. MCZ = Museum of Comparative Zoology.

Trinidad, La Seiva, chapel, parking area (24 Sep 2003; 10.684°N, 61.411°W)

Grenada, Woodlands, sugarcane (28 Jun 2006; 12.025°N, 61.741°W)

Barbados, Flower Forest, garden (29 Nov 2003; 13.202°N, 59.572°W)

Table 2. Earliest known records for *Syllophopsis sechellensis* on Caribbean islands, Neotropics.

Island	Earliest record
Barbados	2003 (Wetterer et al. 2016)
Trinidad[a]	2003 (J. K. Wetterer): La Seiva
Puerto Rico[a]	2005 (J. K. Wetterer): San Juan
St. Croix, US Virgin Islands[a]	2005 (J. K. Wetterer): St. George, Botanical Garden
St. Thomas, US Virgin Islands[a]	2005 (J. K. Wetterer): Nadir
Grenada[a]	2006 (J. K. Wetterer): Woodlands
Mona, Puerto Rico[a]	2006 (J. K. Wetterer): Sardinera Beach
St. Lucia[a]	2006 (J.K. Wetterer): Grande Cul de Sac
St. Martin[a]	2006 (J. K. Wetterer): Colombier
St. Vincent[a]	2006 (J. K. Wetterer): Wallilabou Falls
Martinique[a]	2008 (J. K. Wetterer): Fort-de-France
Guadeloupe[a]	2011 (J. K. Wetterer): Chateaubrun

[a]No previously published records.

St. Vincent, Wallilabou Falls, forest patch (3 Jul 2006; 13.246°N, 61.259°W)

St. Vincent, Sans Souci, grass by beach (6 Jul 2006; 13.296°N, 61.126°W)

St. Lucia, Grande Cul de Sac, north side of bay (8 Jul 2006; 13.987°N, 61.013°W)

Martinique, 1 km southwest of Simon, bananas (12 Jul 2011; 14.584°N, 60.876°W)

Martinique, Grosse Gouttière, secondary forest (18 May 2008; 14.670°N, 61.049°W)

Guadeloupe, Chateaubrun, roadside (7 Jun 2011, 16.250°N, 61.357°W)

Cape Verde, São Nicolau, Ribeira Brava, garden (22 Jul 2003; 16.617°N, 24.294°W)

St. Croix, St. George, botanical garden (1 Nov 2005; 17.716°N, 64.831°W)

St. Croix, Morning Star, roadside (3 Nov 2005; 17.762°N, 64.764°W)

St. Martin, Saint Jean, road to Mt. Fortune, roadside (24 May 2006; 18.049°N, 63.087°W)

St. Martin, Colombier, forest (23 May 2006; 18.073°N, 63.063°W)

Mona Island, Sardinera Beach, beachfront (2 Jun 2006; 18.089°N, 67.938°W)

St. Thomas, Nadir, weeds under large trees (7 Nov 2005; 18.321°N, 64.878°W)

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Puerto Rico, San Juan, Park Luis Muñoz Marín (15 Oct 2005; 18.408°N, 66.073°W)

M. S. also identified numerous specimens of *S. subcoeca* that J. K. W. collected in the West Indies (e.g., from Barbados, Grenada, Guadeloupe, St. Croix, St. Lucia), as well as some from Singapore. Although all previously published records of *S. subcoeca* come from the New World, Torres & Snelling (1997) considered it to be an Old World exotic.

Discussion

Syllophopsis sechellensis has widespread records from the Old World tropics and subtropics, particularly from islands (Table 1; Fig. 1). Recently, Wetterer et al. (2016) reported the first record of *S. sechellensis* in the New World, on the island of Barbados. Here, we report additional Neotropical records, from 11 other islands of the West Indies.

Syllophopsis sechellensis is now known from 6 of the 7 terrestrial bioregions where ants occur: Afrotropics, Indomalaya, Australasia, Oceania, Palearctic, and Neotropics. For such a wide-ranging species, *S. sechellensis* has remarkably few site records. Despite sampling at many sites on Pacific, Atlantic, and West Indian islands, J. K. W. found *S. sechellensis* at no more than 2 sites per island (e.g., 1 of 123 Barbados sites and 1 of 106 Grenada sites; see Results). Whereas *S. sechellensis* may simply be relatively rare throughout most of its range, it seems more likely that this species is overlooked at many sites where it occurs. We expect that more thorough surveys will find that the actual distribution of this species is even broader than currently documented.

Although *S. sechellensis* is certainly native to the Old World, the extent of its original native range (i.e., before being spread by human commerce) is unclear. Wilson & Taylor (1967) wrote "taken at face value, the limited evidence seems to suggest that *fossulatum* is native to tropical Asia and includes in its variation a weakly sculptured form (*sechellense*) that has been distributed to a limited extent by commerce." Dlussky (1994) similarly listed *M. fossulatum* (= *S. sechellensis*) as an Asian species. Sarnat & Economo (2012) listed *S. sechellensis* as a Pacific native. However, the geographic ranges of *S. sechellensis* and other *Syllophopsis* species suggest that *S. sechellensis* may well be native to Madagascar and neighboring islands in the western Indian Ocean. Heterick (2006) noted that in Madagascar, *S. sechellensis* "is found in dry tropical forest and gallery forest habitats." Occurrence in intact native forests is usually indicative of a native species. We found no compelling evidence that *S. sechellensis* is exotic to the western Indian Ocean or to Southeast Asia. It is possible that *S. sechellensis* is native to both these areas. There is, however, an enormous distributional gap between these areas: neither *S. sechellensis* nor any other *Syllophopsis* species has been reported from India, Sri Lanka, or Bangladesh.

Wilson & Taylor (1967) listed *S. sechellensis* (as *M. fossulatum*) in Polynesia as a tramp species "certainly distributed by recent human commerce." Wetterer (2002) and Wetterer & Vargo (2003) listed *S. sechellensis* as an exotic species in Tonga and Samoa. Jourdan (2006) considered *S. sechellensis* to be an invasive species in New Caledonia. Ward (2007) and Ward & Beggs (2007) listed *S. sechellensis* as an invasive species in Fiji. It is striking that the greatest numbers of *S. sechellensis* site records are from Fiji and Hawaii. It is possible that these apparently exotic populations of *S. sechellensis* reach high densities due to escape from natural enemies.

Syllophopsis sechellensis is almost certainly exotic to the isolated Atlantic islands of St. Helena and Cape Verde, and to the New World. *Syllophopsis sechellensis* was first found in the New World in 2003, but is now known from 12 West Indian islands, suggesting that the spread of this species through the West Indies may be fairly recent. Alternatively, earlier specimens of *S. sechellensis* from the West Indies may have been misidentified as *S. subcoeca*, a species that Emery (1894b) described from St. Thomas in the US Virgin Islands, and that was previously the only *Syllophopsis* species known from the New World.

Research on the genetic diversity of *S. sechellensis* at sites around the world is needed to resolve questions concerning the native range and invasion history of this species. Genetic studies should also evaluate Old World specimens identified as *S. subcoeca* to determine whether this species, previously reported only from the Neotropics, may actually be native to the Old World, as are all other known members of the genus.

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