Myrmecological News	18	13-18	Vienna, March 2013

Geographic spread of the samsum or sword ant, *Pachycondyla* (*Brachyponera*) *sennaarensis* (Hymenoptera: Formicidae)

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Abstract

The samsum or sword ant, *Pachycondyla* (*Brachyponera*) *sennaarensis* (MAYR, 1862), is a widespread, conspicuous ant in the savannas and open forests of sub-Saharan Africa and the Middle East. This ant is also common in villages and cities, where it is well known for its powerful sting that sometimes leads to anaphylactic shock in humans and even death. Recent first reports of *P. sennaarensis* from subtropical parts (> 23.4° N) of the Arabian Peninsula and Iran have led many researchers to conclude that populations of this ant are expanding. To evaluate this possibility, I compiled and mapped specimen records of *P. sennaarensis* from > 300 sites. I documented the earliest known *P. sennaarensis* records for 40 countries, including several for which I found no previously published records: Bahrain, Chad, India, Liberia, Mozambique, and Zambia.

In 1925, when most of the world's ant fauna was still poorly documented, *P. sennaarensis* had already been collected from widely shattered locales in 26 countries across tropical Africa and Arabia. In addition, there is a single isolated 1896 record of *P. sennaarensis* from an apparently temporary population in tropical India. All *P. sennaarensis* records from subtropical sites north of 23.4° N (in Bahrain, Kuwait, Iran, Oman, Qatar, the United Arab Emirates, and Saudi Arabia) are from after 1950, except one record from just outside the tropics (Muscat, Oman; 23.6° N). It is possible that *P. sennaarensis* populations have lived in these subtropical areas for a long time, but are only now being reported, perhaps due to a recent population increase of this species. In fact, although the earliest specimen record from Iran dates to 2001, older residents of southeastern Iran remember the sting of *P. sennaarensis* from their childhood. Still, it is possible that *P. sennaarensis* has really expanded its geographic range northeastward into new regions during the past few decades. If true, and if populations of *P. sennaarensis* continue to spread eastward from Iran, through subtropical southern Pakistan, they could soon become established in tropical India, where this species may be expected to thrive.

Key words: Biogeography, biological invasion, pest ants, range expansion.

Myrmecol. News 18: 13-18 (online 24 October 2012)
ISSN 1994-4136 (print), ISSN 1997-3500 (online)

Received 21 September 2011; revision received 15 December 2011; accepted 26 January 2012
Subject Editor: Philip J. Lester

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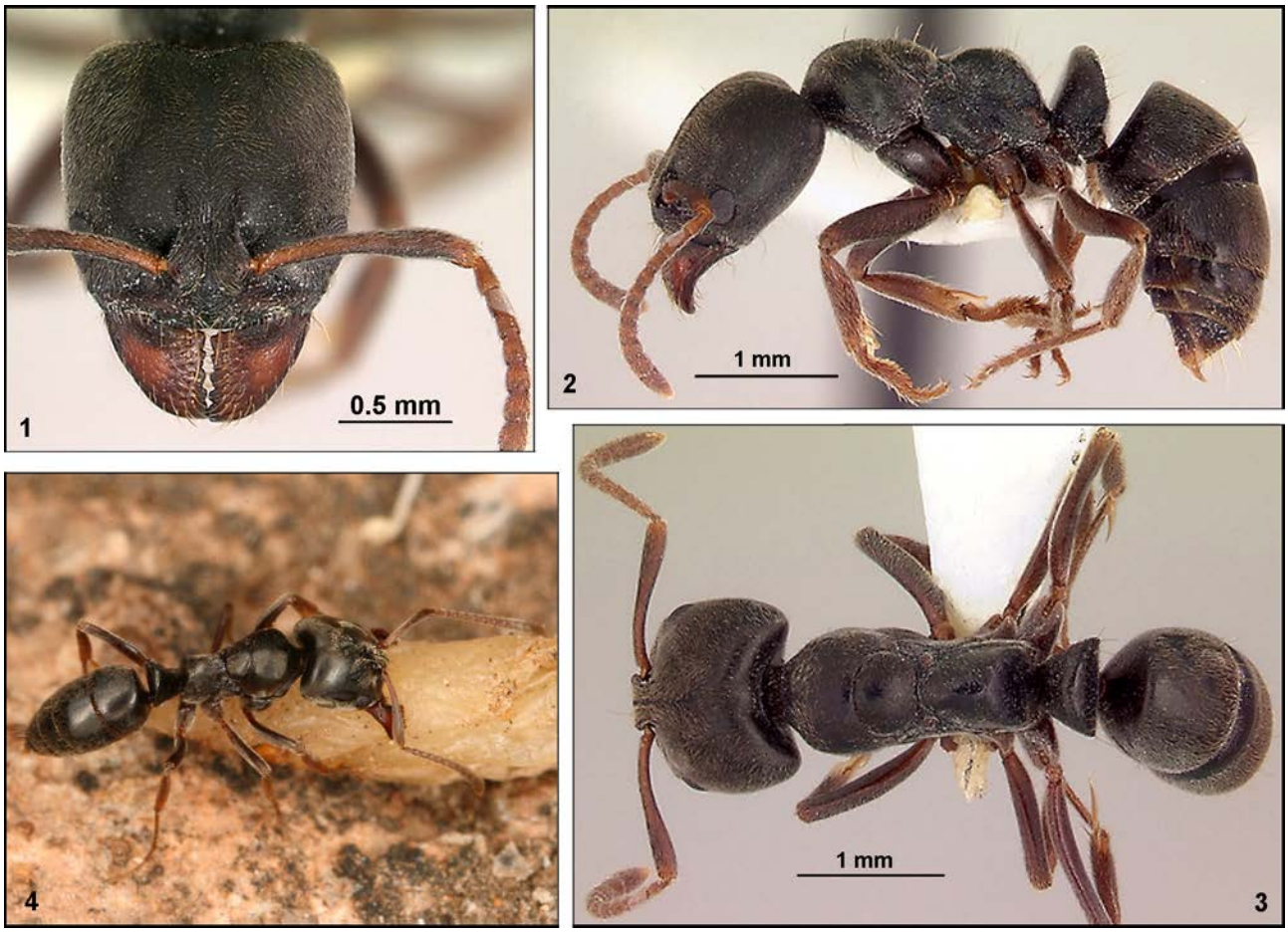
Introduction

Many ant species have been spread around the world through human commerce, and several of these "tramp" ants have had substantial ecological and / or economic impacts. For example, the Argentine ant, *Linepithema humile* (MAYR, 1868), originally from subtropical South America, has spread to subtropical sites around the world (WETTERER & al. 2009), where it is often an important pest. Here, I examine the geographic spread of the sword ant, *Pachycondyla sennaarensis* (MAYR, 1862).

Pachycondyla sennaarensis (Figs. 1 - 4) is a widespread and conspicuous ponerine ant (subfamily Ponerinae) in tropical Africa and the Middle East, well known for its powerful sting. AKBARZADEH & al. (2006a) found that 92.5% of people surveyed in southern Iran had been stung by this ant at least once. Pain from a *P. sennaarensis* sting typically lasts several hours. Some people show allergic reactions to the sting, with not only skin eruptions, but also respiratory problems (DIB & al. 1995). In extreme cases, a *P. sennaarensis* sting can lead to anaphylactic shock (AL-SHAHWAN & al. 2006). DIB & al. (1995) reported that in the United Arab Emirates (UAE) alone "four deaths caused by anaphylactic shock after the sting of this ant have been recorded in the past 4 years". RIZK & al. (1998) reported fetal death after a pregnant woman in the UAE received a single *P. sennaarensis* sting.

In addition to its negative impacts for humans, *P. sennaarensis* can also be beneficial to people. ARNOLD (1915) wrote: "the economic value of this little species can hardly be overestimated, since it is exceedingly plentiful and preys unceasingly on termites." The powerful venom of *P. sennaarensis* is composed of a mixture of many chemicals (NIKBAKHTZADEH & al. 2009a, b). In Saudi Arabia, DKHIL & al. (2010) found anti-inflammatory activity of *P. sennaarensis* venom that may be useful in treatment of inflammatory skin diseases. BADR & al. (2011) found that *P. sennaarensis* venom induces apoptosis in certain human breast cancer cells.

SANTSCHI (1935) reported that *P. sennaarensis* ranged from 20° S to 20° N, from the Kalahari Desert to the Sahara Desert and into southern Arabia. Recent first reports of *P. sennaarensis* from more northern, subtropical (> 23.4°



Figs. 1 - 4: *Pachycondyla sennaarensis.* (1) Head of a worker from Mpulungu, Zambia; (2) lateral view of the same worker; (3) dorsal view of the same worker; (4) foraging worker in Mali (photos 1 - 3 by April Nobile, courtesy antweb.com; photo 4 by D.M. King).

N) parts of the Arabian Peninsula and Iran suggest populations may be expanding, and several recent authors have considered *P. sennaarensis* to be an introduced species in these regions (AKBARZADEH & al. 2006b, PAKNIA 2006, TOURENQ & SHURIQI 2010). *Pachycondyla sennaarensis* is a relative of another important pest, the Asian needle ant, *Pachycondyla chinensis* (EMERY, 1895), an East Asian species now spreading through temperate North America (NELDER & al. 2006). Although not aggressive, *P. chinensis* has a painful sting and severe allergic reactions to stings have been reported (e.g., CHO & al. 2002).

In natural habitats, *P. sennaarensis* is most common in savannas and open forests, where it preys on insects and collects seeds (LEVIEUX & DIOMANDE 1978, DÉJEAN & LACHAUD 1994, LACHAUD & DÉJEAN 1994). This species also does well in urban areas, feeding on human food products and rubbish (COLLINGWOOD & al. 2004). In many parts of its range, *P. sennaarensis* is very common, particularly in disturbed areas. ARNOLD (1915) wrote that *P. sennaarensis* "is the commonest Ponerine ant around Bulawayo" in Zimbabwe. WEBER (1940) wrote of *P. sennaarensis*: "Throughout the Sudan from Port Sudan to the Nile and south to the Belgian Congo and Uganda borders, this ant was found to be one of the commonest insects, nesting abundantly in many areas." *Pachycondyla sennaarensis* was the most frequently collected ant in surveys in Burkina Faso (NISSIM & al. 2003) and on Qeshm Island, Iran (RAFINEJAD & al. 2009). LINDSAY & al. (1989) found *P. sennaarensis* to be the most common ant captured using sticky traps under beds in The Gambia. In 2007, M. Lush (pers. comm.) found that *P. sennaarensis* in The Gambia was "probably one of the most common ant species in the coastal region". In Yemen, COLLINGWOOD & AGOSTI (1996) found that *P. sennaarensis* "thrives around human settlements". DIB & al. (1995) reported that *P. sennaarensis* is common in all urban areas of the UAE and has a strong presence in gardens and buildings. Similarly, COLLINGWOOD & al. (1997) reported that in the UAE, *P. sennaarensis* is "found along all major roadside developments, oases, plantations, and urban areas". I found this to be true in Cape Verde as well (J.K. Wetterer, unpubl.).

WEBER (1940) found *P. sennaarensis* nesting on a Nile River steamboat in Sudan, and concluded that "while *sennaarensis* commonly is found nesting in soil, its ubiquity about cultivations, railway stations, and other civilized places, together with the record here described, suggests that it has characteristics of a successful tropicopolitan, if not cosmopolitan. It may, like the South American *Iridomyrmex humilis* Mayr [= *Linepithema humile*], be another ant observed in historic times to extend its range... Doubtless it will be found in Suez, Egypt, and could spread through the Suez Canal to Mediterranean ports. Eastward

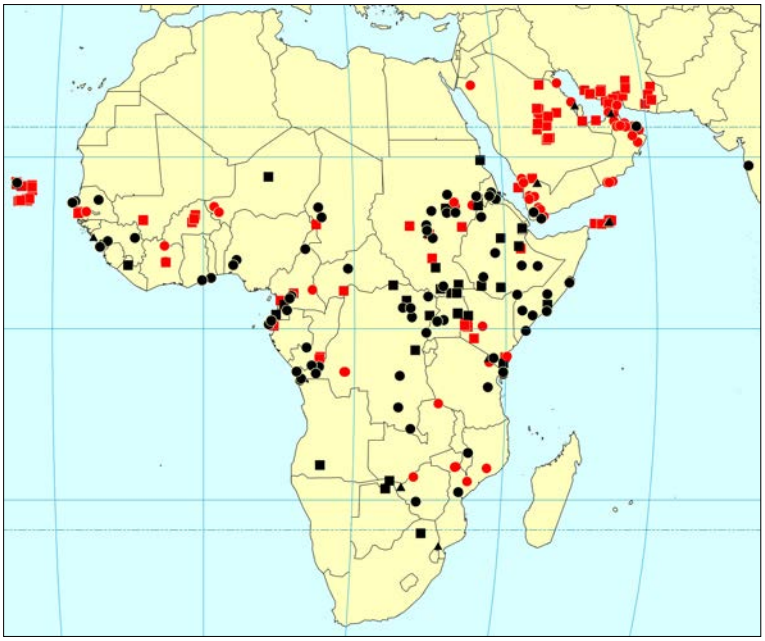


Fig. 5: Site records of *Pachycondyla sennaarensis*. Early records: black circles ≤ 1925, black squares = 1926-1950, black triangles = 1951 - 1975. Recent records: red circles = 1976 - 2000, red squares = 2001 - 2011. Older records overlay newer ones. Dashed lines delimit the tropics.

shipping might readily carry the ant to Bombay and other ports which would involve no appreciable climate change". Here, I compiled and mapped records of *P. sennaarensis* to document its spread and evaluate to what extent WEBER's (1940) predictions on the spread of this ant have come to pass.

Taxonomy

MAYR (1862) described *Ponera sennaarensis* (= *Pachycondyla sennaarensis*) from Sennaar, Sudan. *Ponera sorghi* ROGER, 1863, described one year later from Sudan, is a junior synonym of *P. sennaarensis*. In addition to the nominal subspecies, there are two recognized subspecies: *Pachycondyla sennaarensis ruginota* (STITZ, 1916) and *Pachycondyla sennaarensis decolor* (SANTSCHI, 1921). I have omitted records of these two subspecies because it is not unlikely that these actually represent distinct species. Through numerous revisions, different authors have placed *P. sennaarensis* in different genera including *Ponera*, *Euponera*, *Brachyponera*, and *Pachycondyla*. Most recently, SCHMIDT (2009) removed *P. sennaarensis* from *Pachycondyla*, placing it in the newly revived genus *Brachyponera*, though this revision is not yet official. I therefore use TAYLOR's (2010) subspecific designation: *Pachycondyla* (*Brachyponera*) *sennaarensis*.

Pachycondyla sennaarensis is a medium-size (5 - 6 mm), black, diurnally active ant, known throughout much of the Middle East by the common name samsum ant (DIB & al. 1995, RIZK & al. 1998, AL-SHAHWAN & al. 2006, NIKBAKHTZADEH & al. 2009a, b, DKHIL & al. 2010) or samsun ant (COLLINGWOOD & al. 2004, RAFINEJAD & al. 2009). The word "samsum" (صمصام) is a somewhat archaic Arabic word, also used in Persian, meaning "sharp sword" (M.R. Nikbakhtzadeh, pers. comm.; RICHARDSON 1810). This name no doubt derives from the stabbing pain of a *P. sennaarensis* sting. There are other common names for *P. sennaarensis* in other parts of its range. For example, in Mali, two local Tamachek names for *P. sennaarensis* are "nr5" (pronounced "ənnóri") and "kddkm" (pronounced "kədədəkkum") (HEATH 2006). For use outside of the Middle East, I have coined an English common name for *P. sennaarensis*, "sword ant", based on its common name in Arabic and Persian.

Methods

Using published and unpublished records, I documented the worldwide range of *P. sennaarensis*. I obtained unpublished site records from museum specimens in the collections of the Muséum National d'Histoire Naturelle, Paris (MNHN; identified by J.C. Weulersse-Casevitz), the Museum of Comparative Zoology (MCZ; identified by earlier researchers), and the Smithsonian Institution (SI; identified by earlier researchers). Almost all specimen records from the MCZ and SI matched published records. In addition, I used on-line databases with collection information on specimens by Antweb (www.antweb.org) and the Global Biodiversity Information Facility (www.gbif.org). I also received unpublished records from M. Lush (The Gambia, Senegal), D.M. King (Mali, Qatar), A. Heinrichs (Ivory Coast), B. Guénard (Oman, United Arab Emirates), and C. Collingwood (Cape Verde). In 2003, I collected *P. sennaarensis* on the islands of Cape Verde. In 2012, I collected *P. sennaarensis* in Zimbabwe and the United Arab Emirates.

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 www.fallingrain.com). For older references and specimens, many site names, particularly in Arabia, 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. The only exception was Kuwait, where I mapped a southern town (Al Khiran) because the capital was farther

Tab. 1: Earliest known records for *Pachycondyla sennaarensis* from Africa. + = no previously published records. IMC = Iziko Museum of Capetown. MCZ = Museum of Comparative Zoology. MNHN = Muséum National d'Histoire Naturelle, Paris. SI = Smithsonian Institution.

	Earliest record
Sudan	≤ 1862 (MAYR 1862)
Ethiopia	≤ 1877 (EMERY 1877)
Senegal	1886 (EMERY 1892a)
Somalia	≤ 1891 (EMERY 1892b)
Ghana	≤ 1895 (MAYR 1895)
Gabon	≤ 1895 (MAYR 1895)
South Sudan	1901 (MAYR 1904)
Cameroon	1904 (E. Lenfant, MNHN): Mayo-Kebbi
+ Chad	1904 (A. Chevalier, MNHN): Massakori
Uganda	1905 (M. de Rothschild, MNHN): Mt. Lorogmi
Tanzania	1903 - 1905 (FOREL 1907)
+ Mozambique	1906 (C. Vasse, MNHN): Pungoué-Guengere
Guinea	1906 (A. Chevalier, MNHN): Koba
Congo (Rep.)	≤ 1909 (SANTSCHI 1909)
Congo (Zaire)	1909 (FOREL 1913)
Eritrea	≤ 1910 (FOREL 1910)
Equatorial Guinea	≤ 1910 (STITZ 1910)
CAR	1911 (STITZ 1916)
Kenya	1912 (SANTSCHI 1914a)
Zimbabwe	≤ 1913 (FOREL 1913)
Nigeria	≤ 1914 (SANTSCHI 1914b)
Cape Verde	1914 (E. André, MNHN): site unknown
Malawi	≤ 1922 (AUSTEN & HEGH 1922)
Angola	≤ 1925 (BEQUAERT 1925)
Botswana	1930 (G. Van Son, MCZ): Tsotorogo Pan
South Africa	1931 (H.O. Lang, MCZ): Saltpan, N. Transvaal
+ Liberia	1940 (W.M. Mann, SI): Belleyella
Niger	≤ 1950 (BERNARD 1950)
Ivory Coast	≤ 1977 (LÉVIEUX & DIOMANDE 1978)
Burkina Faso	≤ 1977 (LÉVIEUX & DIOMANDE 1978)
+ Zambia	1986 (R.J. Nefdt, IMC): Mpulungu
Gambia	1987 (LINDSAY & al. 1989)
Mali	≤ 2006 (HEATH 2006)

north than any known record. MENOZZI (1931) reported *P. sennaarensis* from Dancalia (Danakil), a region that encompasses much of Djibouti, but also extends into southern Eritrea and northeastern Ethiopia. Although I mapped it to Djibouti, I did not assign a country designation for this record.

Tab. 2: Earliest known records for *Pachycondyla sennaarensis* from the Arabian Peninsula and Asia. Abbreviations as in Table 1.

	Earliest record
Oman	1879 - 1880 (EMERY 1881)
Yemen	1879 - 1880 (EMERY 1881)
+ India	1896 (M. Maindron, MNHN): Mathéran
+ Bahrain	1951 (N.A. Weber, MCZ): site unknown
UAE	1972 (COLLINGWOOD 1985)
Saudi Arabia	1978 (COLLINGWOOD 1985)
Kuwait	1988 - 1989 (COLLINGWOOD & AGOSTI 1996)
Iran	2001 (TIRGARI & PAKNIA 2005)
Qatar	2005 (D.M. King, pers. comm.): near Doha

Results

I compiled and mapped specimen records of *Pachycondyla sennaarensis* from > 300 sites. I documented the earliest known *P. sennaarensis* records for 40 countries, including several for which I found no previously published records: Bahrain, Chad, India, Liberia, Mozambique, and Zambia (Tabs. 1 - 2). I found records of *P. sennaarensis* from all countries of tropical Sub-Saharan Africa except Benin, Burundi, Djibouti, Guinea-Bissau, Mauritania, Namibia, Rwanda, Sierra Leone, and Togo. I expect that *P. sennaarensis* probably occurs in all these countries. I found records of *P. sennaarensis* from all countries of the Arabian Peninsula. There is also a single isolated 1896 record of *P. sennaarensis* from an apparently temporary population in tropical India, near Mumbai (Tab. 2). I collected *P. sennaarensis* at 41 sites distributed across all nine inhabited islands of Cape Verde. I found *P. sennaarensis* most often in urban gardens and wooded parks.

Most records of *P. sennaarensis* come from tropical sites (Fig. 5). Only five site records come from latitudes > 28°: Kuwait (~ 29° N; COLLINGWOOD & AGOSTI 1996), Iran (Jiroft: 28.9° N & Khash: 28.2° N; PAKNIA 2006), and Saudi Arabia (NW of Tobuk: 28.4° N; COLLINGWOOD 1985 & Hafr-Al-Batin: 28.4° N; AL-SHAHWAN & al. 2006).

Erroneous and questionable records

I did not include two questionable records that DONISTHORPE (1942) reported from Egypt as "*Euponera* (*Brachyponera*) *sorghi* Roger ?" (Siwa: 29.3° N & Maragi: 29.3° N), because these are very likely to be misidentifications, particularly because DONISTHORPE (1942) was unaware that the name he used had been synonymized and I found no other paper by Donisthorpe that refers to *P. sennaarensis*. In addition, these records are from higher latitudes than any records for *P. sennaarensis*. MAYR (1895) reported *P. sennaarensis* specimens from the Chûtes de Samlia, French Congo (now Gabon), but WHEELER (1922) incorrectly reported that this site was in Sierra Leone. ALANAZI & al. (2009) wrote that *P. sennaarensis* "is believed to be indigenous to Southeast Asia", no doubt confusing this species with *P. chinensis*.

Discussion

The range of *Pachycondyla sennaarensis* appears to be essentially continuous across tropical Africa and into the Middle East (Fig. 5). In 1925, when most of the world's ant fauna was still poorly documented, *P. sennaarensis* had already been collected from locales in 26 countries across tropical Africa and Arabia (Tabs. 1 - 2; dark green circles in Fig. 5). However, in subtropical areas (> 23.4°), all records date to after 1975 (red and orange circles in Fig. 5), except five records (green circles in Fig. 5); from Muscat, Oman (23.6° N; EMERY 1881), North Transvaal, South Africa (23.9° S; Tab. 1), Dubai, UAE (25.2° N; Tab. 1), Kruger National Park, South Africa (25.3° S; PRINS 1963), and Bahrain (26.0° N; Tab. 1). Subtropical records include all reports from Kuwait, Iran, the UAE, and Qatar, as well as most from Saudi Arabia and some from Oman. It is possible that small populations of *P. sennaarensis* have lived in these subtropical areas for a long time, but are only now being reported, possibly due to a population increase of the ants. Alternatively, *P. sennaarensis* may have only recently expanded into these regions. If the expansion is recent, it is possible that open deserts posed a geographic barrier that prevented an earlier expansion, and increased human commerce has provided *P. sennaarensis* transport into subtropical areas. Or perhaps permanent human habitations and other structures in this region now provide winter refuges for these ants. Alternatively, larger and more affluent human populations may have simply provided richer food resources necessary to allow *P. sennaarensis* to be more competitive in these cooler areas. Finally, global warming may play a role in allowing the expansion of ant populations in more northern areas.

Concerning these alternatives, Nikbakhtzadeh (pers. comm.) wrote about *P. sennaarensis*: "I believe that this species has been present in some of the current locations of the Middle East since long ago, e.g., records of south and southeastern Iran... Human population growth and spreading of human dwellings to the ant's colonies brought them into further contact with the local residents... So it came into more attention, in particular because of the health concerns. Based on my personal query, the residents of southeastern Iran, even the seniors, remember the Samsum ant sting since their childhood. So occurring of these ants in that region cannot be a new phenomenon." Search for unpublished *P. sennaarensis* in additional museums could confirm an earlier presence of this ant in subtropical parts of the Middle East.

Except for the 1896 record from India, I found no other evidence that *P. sennaarensis* has been carried by ship to colonize distant port cities as WEBER (1940) predicted. Nor has it invaded the Mediterranean region, which appears to have a climate too cool for *P. sennaarensis*. There are, however, many other places in the world with a tropical climate quite suitable for *P. sennaarensis*. If populations of *P. sennaarensis* spread eastward from Iran, through subtropical southern Pakistan, they may soon become established in tropical India, where, as WEBER (1940) pointed out, this species may be expected to thrive. Because of the medical importance of this ant, it would be useful to survey ants in southern Pakistan and western India to monitor the possible spread of *P. sennaarensis* through these regions.

Acknowledgements

I thank M. Wetterer, O. Paknia, M.R. Nikbakhtzadeh, and J.-P. Lachaud, for comments on this manuscript; S. Cover and X. Espadaler for help, encouragement, and ant identification; J.C. Weulersse-Casevitz, M. Lush, D. King, A. Heinrichs, B. Guénard, and C. Collingwood for providing unpublished records; S. Cover (MCZ) and T. Schultz (SI) 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 for financial support.

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