

Recent Collection of Sandflies of the Genus *Phlebotomus* (Diptera: Psychodidae) from Jordan, with a Checklist of Previous Records

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Abstract

Five species of sand flies (*Phlebotomus alexandri*, *Phlebotomus major syriacus*, *Phlebotomus mascitti canaaniticus*, *Phlebotomus papatasi* and *Phlebotomus sergenti*) were collected from several localities from Jordan. *Phlebotomus papatasi* was the most common species. A checklist of previous records for sand flies of the genus *Phlebotomus* is given.

Keywords: Jordan, Sandflies, *Phlebotomus*, Distribution.

1. Introduction

Sand flies (*Phlebotominae*) are hematophagous insects of the subfamily Psychodidae within the order of Diptera. Many species are involved in the transmission of viral and protozoan diseases that can affect human health. In Jordan, Leishmaniasis is the major disease that is transmitted by sand flies of the genus *Phlebotomus* (Oumish *et al.*, 1982; Saliba *et al.*, 1985; Kamhawi *et al.*, 1993; Janini *et al.*, 1995; Khoury *et al.*, 1996; Mosleh *et al.*, 2009).

Janini *et al.* (1995a) investigated the status of sand flies as vectors of cutaneous leishmaniasis in the southern Jordan Valley during 1992. Of 686 *Phlebotomus papatasi* females collected from burrows of the Fat Sand Jird, 14 harboured promastigotes in their guts. Their findings present the first direct evidence of the role of *P. papatasi* as a vector of *Leishmania major* in Jordan.

Since then, no studies have been carried out on the distribution of sand flies in Jordan. The present study investigates the current spatial distribution of sand flies in Jordan, with a list of these flies belonging to the genus *Phlebotomus*.

2. Materials and Methods

Twenty five localities in Jordan were examined for the presence of sand flies (Table 1, Figure 1).

Sand flies were collected either by sticky traps that consist of 21x30 cm white paper sheets coated by castor oil and held with a metal stand above ground surface, CDC light traps were set 1 h before sunset and collected after sunrise next morning or by aspirator tube from inside houses. Insects were then washed from the sticky traps, sorted, and examined for species determination. Identification of collected material was based on Lewis (1982) and Lane *et al.* (1988).

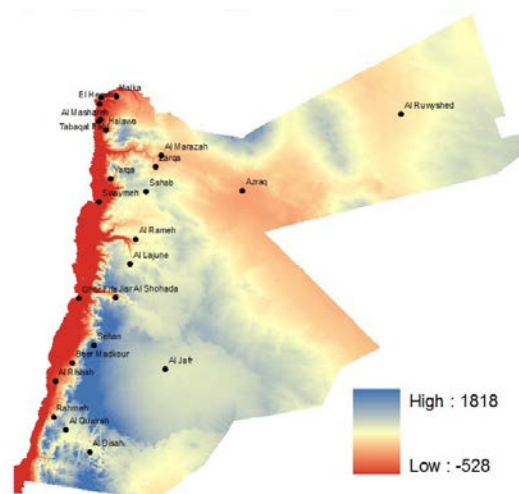


Figure 1. Map of Jordan showing localities from which sand flies were collected

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Table 1. Localities and their coordinates from which sand flies were collected.

Locality	N	E
Al Adasyeha	32° 40' 08"	35° 37' 30"
Al Disah	29° 41' 50"	35° 23' 40"
Al Jafr	30° 18' 52"	36° 10' 00"
Al Lajune	31° 14' 20"	35° 52, 49"
Al Marazah	32° 24' 47"	35° 35' 19"
Al Mashareh	32° 25' 49"	35° 35' 30"
Al Quairah	29° 46' 53"	35° 18' 10"
Al Rameh	31° 49' 00"	35° 43' 13"
Al Rishah	30° 13' 29"	35° 13' 07"
Al Ruwysheed	32° 30' 38"	38° 12' 09"
Azraq	31° 51' 26"	36° 49' 40"
Beer Madkour	30° 26' 27"	35° 17' 08"
El Hemma	32° 26' 34"	35° 35' 47"
Ghor Fifa	30° 55' 38"	35° 27' 36"
Halawa	32° 22' 47"	35° 41' 32"
Jisr Al Shohada	30° 57' 42"	35° 44' 29"
Malka	32° 39' 40"	35° 43' 09"
Osarah	32° 23' 10"	35° 41' 15"
Rahmeh	29° 54' 46"	35° 08' 34"
Sahab	31° 54' 04"	36° 01' 47"
Sehan	32° 11' 28"	35° 43' 40"
Swaymeh	31° 48' 15"	35° 35' 44"
Tabaqat Fahl	32° 26' 46"	35° 36' 10"
Yarqa	31° 58' 48"	35° 42' 00"
Zarqa	32° 02' 54"	36° 04' 05"

3. Results

A total of five species of sand flies belonging to the genus *Phlebotomus* was identified.

Phlebotomus alexandri (Sinton, 1928)

Material examined (23): El Hemma (1), 19.7.2009. Halawa (1), 11.8.2009. Jisr Al Shohada (3), 17.8.2009. El Hemma (3), 1.10.2009. Tabaqat Fahl (1), 1.10.2009. Al Marazah (1), 1.10.2009. Al Mashareh (5), 1.10.2009. Al Rameh (1), 26.11.2013. Rahmeh (2), 14.5.2014. Al Adasyeha (4), 20.5.2014. Ghor Fifa (1), 10.9.2014.

Remarks: Figure 2 shows the distribution of *Ph. alexandri*. This species was collected previously from Tabaqat Fahl (Lane *et al.*, 1988), and from Jarash, Amman. Petra, El Hemma, Tabaqat Fahl, Wadi Dhulail, Ras en Naqb, Swaima, Aqaba, South Shounah, and Tafileh mountains (Kamhawi *et al.*, 1995). It was found to be associated with different types of biogeographical regions including the Mediterranean, Irano-Turanian and the Saharo-Arabian.

Phlebotomus major syriacus (Adler & Theodor, 1958)

Material examined (68): El Hemma (1), 19.7.2009. Halawa (5), 11.8.2009. Al Mashareh (13), 1.9.2010. Halawa (1), 15.9.2009. Azraq (1), 29.10.2009. Malka (39), 8.10.2009. Sehan (1), 21.11.2013. Malka (5), 20.5.2014. Osarah (1), 26.5.2014. Sahab (1), 21.8.2014.

Remarks: *Phlebotomus major syriacus* was found in the northern Ghor area to Azraq. It was found along with *Phlebotomus alexandri* in El Hemma in the Northern Ghor. However, it is mostly associated with the Ajlun and Irbid highlands (Figure 3). Lane *et al.* (1988) listed a number of localities for this species, including Barha, Hawarrah, Umm Qais, Ras el Naqb and South Shounah. Other reported localities include Ajlun, Salt, Irbid, Jarash,

Petra, El Hemma, Umm Qais, Ras en Naqb and Swaima (Kamhawi *et al.* 1995).

Phlebotomus mascitti canaaniticus (Adler and Theodor, 1931)

Material examined (3): Halawa (2), 11.8.2009. Al Adasyeha (1), 20.5.2014.

Remarks: *Phlebotomus mascitti canaaniticus* was collected during this study in low numbers from the upper northern Jordan Valley and Ajlun area. It was reported from Ajlun, Petra, El Hemma and Swaima (Kamhawi *et al.*, 1995). Figure 4 shows the distribution of *Ph. m. canaaniticus*.

Phlebotomus papatasi (Scopoli, 1786)

Material examined (1085): El Hemma (2), 29.5.2009. El Hemma (15), 19.7.2009. El Hemma (7), 17.8.2009. El Hemma (9), 30.8.2009. El Hemma (17), 1.10.2009. Tabaqat Fahl (1), 29.5.2009. Tabaqat Fahl (12), 19.7.2009. Tabaqat Fahl (21), 17.8.2009. Tabaqat Fahl (3), 30.8.2009. Tabaqat Fahl (9), 1.10.2009. Al Marazah (2), 29.5.2009. Al Marazah (5), 19.7.2009. Al Marazah (6), 17.8.2009. Al Marazah (6), 30.8.2009. Al Marazah (11), 1.10.2009. Al Mashareh (12), 29.6.2009. Al Mashareh (18), 31.7.2009. Al Mashareh (37), 17.8.2009. Al Mashareh (18), 30.8.2009. Al Mashareh (37), 1.10.2009. Al Mashareh (3), 27.10.2009. Al Mashareh (1), 31.12.2009. Al Mashareh (13), 1.9.2010. Swaymeh (18), 27.7.2009. Swaymeh (30), 3.8.2009. Azraq (7), 29.10.2009. Jisr Al Shohada (61), 17.8.2009. Yarqa (56), 7.9.2009. Al Quairah (17), 29.9.2009. Malka (50), 8.10.2009. Halawa (22), 11.8.2009. Halawa (29), 24.8.2009. Halawa (104), 15.9.2009. El Hemma (8), 18.11.2009. Sehan (5), 21.11.2013. Al Rameh (4), 26.11.2013. Beer Madkour (7), 15.4.2014. Rahmeh (15), 14.5.2014. Malka (38), 20.5.2014. Al Adasyeha (26), 20.5.2014. Osarah (3), 26.5.2014. Halawa (3), 27.5.2014. Azraq (21), 28.5.2014. Al Rishah (5), 3.6.2014. Al Disah (17), 4.6.2014. Al Quairah (13), 4.6.2014. Al Lajune (7), 9.6.2014. Jisr Al Shohada (19), 9.6.2014. Zarqa (15), 22.6.2014. Al Jafr (3), 24.6.2014. Al Damkhi (2), 30.6.2014. Al Mowaqar (3), 6.7.2014. Al Ruwysheed (4), 14.8.2014. Aqraba (2), 18.8.2014. Sahab (3), 21.8.2014. Ghor Fifa (2), 10.9.2014.

Remarks: *Phlebotomus papatasi* was the most common species with a distribution that covers most of the study sites. This species was found in almost all types of habitats in the Jordan Valley, southern Jordan as well as in Azraq area to the East. It was collected from Barha, Bushra, Hawarrah, Umm Qais, Ras el Naqb, Swaima, Azraq and South Shounah (Lane *et al.*, 1988). Kamhawi *et al.* (1995) included localities from several localities extending from Irbid to Aqaba and the Jordan Valley (Figure 5).

Phlebotomus sergenti (Parrot, 1917)

Material examined (49): El Hemma (1), 1.10.2009. Tabaqat Fahl (2), 1.10.2009. Al Marazah (1), 1.10.2009. Al Mashareh (4), 1.10.2009. Yarqa (8), 7.9.2009. Malka (13), 8.10.2009. Halawa (5), 11.8.2009. Halawa (3), 24.8.2009. Sehan (1), 21.11.2013. Malka (2), 20.5.2014. Osarah (1), 26.5.2014. Halawa (2), 27.5.2014. Al Disah (1), 4.6.2014. Al Quairah (4), 4.6.2014. Jisr Al Shohada (1), 9.6.2014.

Remarks: *Phlebotomus sergenti* was found in the Jordan Valley, Balqa highlands and Wadi Rum area (Figure 6). *Ph. sergenti* is known to be highly anthropophilic, but can also be found in rural habitats. Collected from Barha, Bushra and Azraq (Lane *et al.*, 1988).

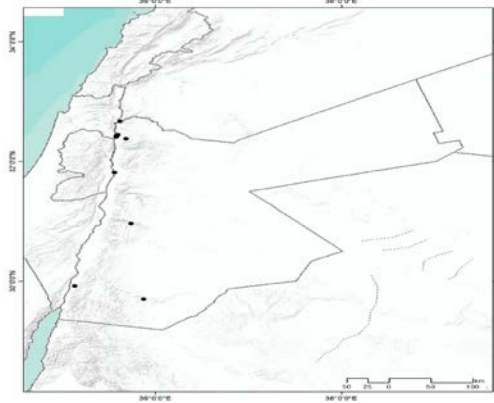


Figure 2. Distribution of *Phlebotomus alexandri* in Jordan

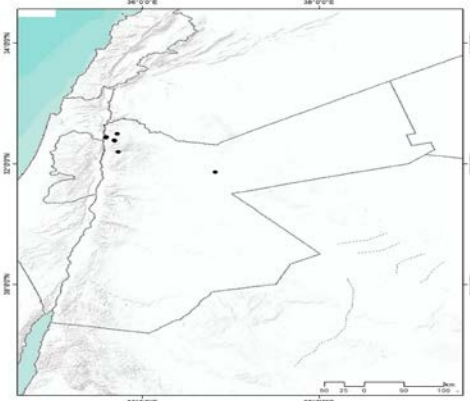


Figure 3. Distribution of *Phlebotomus major syriacus* in Jordan

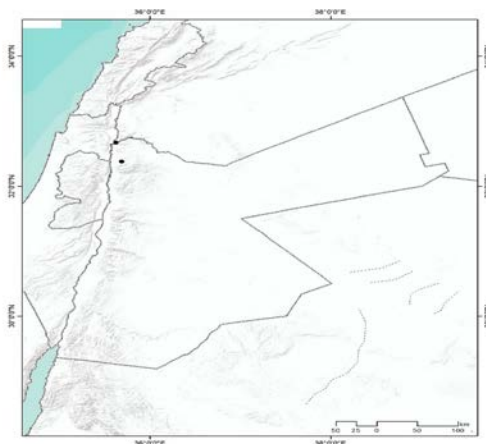


Figure 4. Distribution of *Phlebotomus mascitti canaaniticus* in Jordan

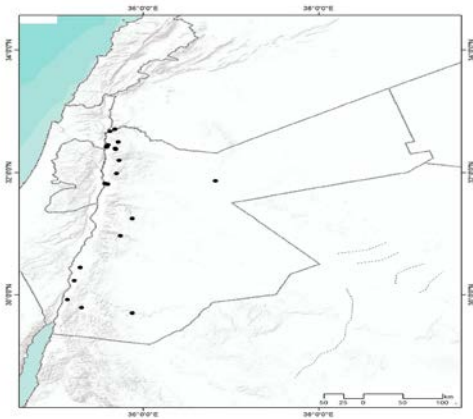


Figure 5. Distribution of *Phlebotomus papatasi* in Jordan

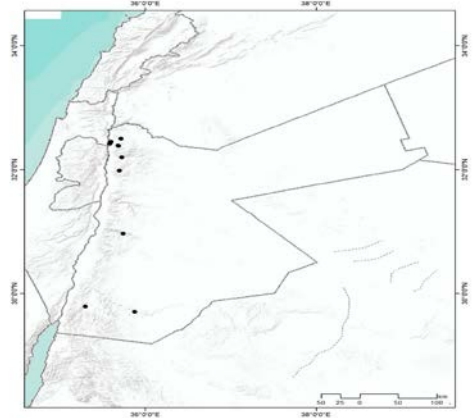


Figure 6. Distribution of *Phlebotomus sergenti* in Jordan

4. Review of sand flies of Jordan of the genus *Phlebotomus*

In Jordan, the genus *Phlebotomus* includes 11 species (Table 2). The first record of sand flies from this country was indicated in Adler and Theodor (1929), where they reported *Ph. sergenti* and *Ph. papatasi*. The first study by locals on the sand flies was published by Oumeish *et al.* (1982) who reported the presence of one species, *Ph. papatasi*, from several locations. Later, Lane *et al.* (1988) conducted a comprehensive study that covered several bioclimatological regions, and reported 13 species of sand flies (six *Phlebotomus* and 7 *Sergentomyia*). Kamhawi *et al.* (1988) reported on the sand flies of Aqaba area, and recorded eight species, three of which belong to the genus *Phlebotomus*. In 1991, Kamhawi *et al.* studied the sand flies of Ras el Naqab, and reported a total of nine species (5 *Phlebotomus* and 4 *Sergentomyia*). In a large-scale study, Kamhawi *et al.* (1995) studied the sand flies fauna of the country and reported a total of 21 sand fly species including additional records (*Phlebotomus jacusieli*, *Ph. tobbi*, *Ph. perfiliewi galilaeus*, *Ph. mascitti*, *Ph. arabicus*, *Ph. halepensis*, *Sergentomyia palestiniensis* and *S. toizi*).

Eleven species of sand flies were recorded in the southern Jordan Valley, including *P. kazeruni*, *P. tobbi* and *Sergentomyia squamipleuris*. *Phlebotomus papatasi* was the most abundant species collected from domestic habitats (Janini *et al.*, 1995). Table 2 lists the known species of *Phlebotomus* sand flies in Jordan to which we added the records noted above.

Table 2. Records of species of the genus *Phlebotomus* in Jordan

Species	Localities	References
<i>Ph. alexandri</i> (Sinton, 1928)	Barha, Tabaqat Fahl, Hawarrah, Ras el Naqb, South Shounah, Umm Qais	Lane <i>et al.</i> (1988)
	Aqaba	Kamhawi <i>et al.</i> (1988)
	Ras el Naqb	Kamhawi <i>et al.</i> (1991)
	Amman, Aqaba, Jarash, El Hemma, Petra, Ras el Naqb, South Shounah, Swaima, Tabaqat Fahl, Wadi Dhulail	Kamhawi <i>et al.</i> (1995)
		Kamhawi <i>et al.</i> (1995)
<i>Ph. arabicus</i> Theodor, 1953	Ajlun, El Hemma, Petra, Ras en Naqb.	Kamhawi <i>et al.</i> (1995)
<i>Ph. halepensis</i> Theodor, 1958	Ajlun, El Hemma, Petra, Ras en Naqb.	Kamhawi <i>et al.</i> (1995)
<i>Ph. jacusieli</i> Theodor, 1947	Ajlun, Amman, El Hemma, Irbid, Jarash, Petra, Ras en Naqb, Shoubak.	Kamhawi <i>et al.</i> (1995)
<i>Ph. kazeruni</i> Theodor & Mesghali, 1964	Azraq, Ras el Naqb, Aqaba	Lane <i>et al.</i> (1988)
	Aqaba	Kamhawi <i>et al.</i> (1988)
	Ras el Naqb.	Kamhawi <i>et al.</i> (1991)
	Irbid, Jarash, Shoubak	Kamhawi <i>et al.</i> (1995)
<i>Ph. major syriacus</i> Adler & Theodor, 1958	Jordan	Perfil'ev (1968)
	Barha, Hawarrah, Ras el Naqb, South Shounah, Umm Qais	Lane <i>et al.</i> (1988)
	Ajlun, El Hemma, Irbid, Jarash, Petra, Ras en Naqb, Salt, Swaima, Umm Qais	Kamhawi <i>et al.</i> (1995)
<i>Ph. mascittii</i> Grassi, 1908	Ajlun, El Hemma, Petra, Swaima	Kamhawi <i>et al.</i> (1995)
<i>Ph. papatasi</i> (Scopoli, 1786)	Awajan, Sweilah	Lewis (1982)
	Swaima	Oumeish <i>et al.</i> (1982)
	Mowoqqar	Saliba <i>et al.</i> (1985)
	Ajlun, Amman, Azraq, Barha, Bushra, Hawarrah, Irbid, Jarash, Ras el Naqb, South Shounah, Swaima, Umm Qais	Lane <i>et al.</i> (1988)
	Aqaba	Kamhawi <i>et al.</i> (1988)
	Ras el Naqb.	Kamhawi <i>et al.</i> (1991)
	Aqaba, Azraq, El Hemma, Ghor el Safi, Ras en Naqb, South Shounah, Swaima, Tabaqat Fahl, Wadi Dhulail	Kamhawi <i>et al.</i> (1995)
		Kamhawi <i>et al.</i> (1995)
<i>Ph. perfiliewi galilaeus</i> Theodor, 1958	Irbid, El Hemma.	Kamhawi <i>et al.</i> (1995)
<i>Ph. sergenti</i> Parrot, 1917	Awajan.	Lewis (1982)
	Mowoqqar	Saliba <i>et al.</i> (1985)
	Barha, Bushra and Azraq	Lane <i>et al.</i> (1988)
	Ras el Naqb	Kamhawi <i>et al.</i> (1991)
<i>Phlebotomus tobbi</i> Adler and Theodor, 1934	El Hemma, Irbid, Ras en Naqb, Umm Qais	Kamhawi <i>et al.</i> (1995)

5. Discussion

Five species of sand flies were identified during the present study. Our results are consistent with those reported by Lane *et al.* (1988). For example, *Ph. major syriacus* was the dominant *Phlebotomus* species in Ajlun Mountains and Balqa, where it was collected from domestic as well as rural habitats. Also, *Ph. sergenti* was the least common species, while *Ph. papatasi* was the dominant species.

The distribution of sand flies may vary according to season. Lane *et al.* (1988) recorded *Ph. alexandri*, *Ph. sergenti* and *Ph. major syriacus* in Tabaqat Fahel in the Jordan Valley, while we reported *Ph. alexandri*, *Ph. papatasi* and *Ph. sergenti* from the same locality. Similarly, we recorded *Ph. papatasi* and *Ph. major*

syriacus, while Lane *et al.* (1988) found *Ph. papatasi* and *Ph. sergenti* from Al Hemma.

Phlebotomus papatasi is considered the most important vector for *L. major* in Jordan (Saliba *et al.*, 1985; Janini *et al.*, 1995). Its distribution overlaps with the distribution of human cases. On the other hand, *Ph. sergenti* is the main vector for *L. tropica* in Bani Kananah area. This is in accordance with the present distribution of *Ph. sergenti*. Elsewhere, Orshan *et al.* (2010) stated that *Ph. sergenti* is the most common outdoor species in the Judean Desert, while Sawalha *et al.* (2003) found that *Ph. perfiliewi* was the most common species in the areas of the West Bank of Jordan.

Further studies should address the distribution and bionomics of the sand flies of Jordan for several seasons. Identification manual for the sand flies of Jordan is urgently needed in addition to training entomologists for the use of identification keys.

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