

## Checklist and Geographical Distribution of *Phlebotomine* Sand flies (Diptera: Psychodidae) vectors of leishmaniasis in Esfahan province, Iran

A. Zahraei-Ramazani<sup>1\*</sup>, M. Sedaghat<sup>2</sup>

1- Assistant Professor, Department of Medical Entomology and Vector Control, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

2- Associate Professor, Department of Medical Entomology and Vector Control, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

### Abstract

Phlebotomine sand flies are reported as the vectors of different kinds of leishmaniasis and arboviruses to human. Three forms of leishmaniasis, namely: visceral, zoonotic cutaneous and anthroponotic cutaneous affect Esfahan province. Antibodies against three arboviruses, Nepales, Sicilian and Karimabad, were found from serum and blood specimen residents in this province too. The aim of this study was to prepare a checklist and geographical distribution of *Phlebotomine* sand flies as vectors of the agents from Esfahan province. In the field work, sand flies were collected by sticky paper traps from 10 collection stations of Natanz, Mobarakeh, Shahreza and Esfahan city areas of Esfahan province during 2006 to 2013. Also literature review was done on all published reports which have been done by researchers on *Phlebotomine* sand flies in this province during 1968 to 2013. A total of 170380 specimen sand flies revealed 28 species are in this province. *Phlebotomus papatasi* as the main vector of zoonotic cutaneous leishmaniasis and arboviruses and also *P. sergenti* as the main vector of anthroponotic cutaneous leishmaniasis were collected from all areas of this province. Also *P. alexandri*, *P. major*, *P. kandelaki* and *P. keshishiani* as suspected vectors of visceral leishmaniasis in Iran were found in this province. The geographical distribution of each 28 species of sand flies in Esfahan province and some important notes of them is demonstrated in this article.

**Key Words:** Checklist, Geographical Distribution, *Phlebotomine* Sand flies, Esfahan Province, Iran

\* Corresponding Author, E-mail: [alirezazahraei@yahoo.com](mailto:alirezazahraei@yahoo.com)

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## Introduction

Sand flies are classified in order Diptera, suborder Nematocera, family Psychodidae and subfamily Phlebotominae (Seyedi-Rashti Nadim, 1992). The subfamily contains 5 genera which *Phlebotomus* Rondani & Berte, 1840 (with 10 subgenus), and *Sergentomyia* France & Parrot, 1920 (with 7 subgenus & 1 species-group) are in the old world (Lewis *et al.*, 1977; Lewis, 1982).

The *Phlebotomine* sand flies are blood-sucking insects (Artemiev, 1978). The identification of sand fly species is epidemiologically very important because less than 10 percent of over 800 species described are responsible for the transmission of human pathogens such as flagellate protozoa of the genus *Leishmania* (Kato *et al.*, 2010) in more than 80 countries in the old and new world (Depaquit *et al.*, 2010).

Three species of leishmania have been incriminated as the causative agents of human leishmaniasis infection (Nadim & Seyedi-Rashti, 1971) namely: Visceral (VL due to *L. infantum*), Zoonotic Cutaneous (ZCL due to *L. major*) and Anthroponotic Cutaneous (ACL due to *L. tropica*) (W.H.O, 2004) in Iran.

In Esfahan province the VL cases were not indigenous and it had sporadic cases that most came in the summer time from neighboring provinces (Tabatabaai *et al.*, 1975) but recently some autochthonous cases were reported from Shahreza in this province (Emami & Yazdi, 2008).

A rural area to the north and east of the city of Esfahan, among the foothills of the Karkas mountains in central Iran is hyper endemic area of Zoonotic Cutaneous leishmaniasis (ZCL) because in this area intensities transmission occurs, so that many indigenous residents acquire the disease before the age of five and almost 80% of all reported cases of ZCL in this country is from Esfahan province (Nadim *et al.*, 1988; Yaghoobi-Ershadi *et al.*, 2005).

Anthroponotic Cutaneous leishmaniasis (ACL) reported from Esfahan city on the basis of epidemiological data, clinical manifestation (Zahraei-Ramazani *et al.* 2007) confirmed by isoenzyme (Hatam *et al.*, 2005), and also *L. tropica* parasite isolated from active lesions of infected patients in the city of Esfahan (Farid-Moaeir *et al.*, 1997).

Sand flies also are vectors of some viruses and the frequency of human infection with *Phlebotomus* fever viruses is high in Iran (Tesh *et al.*, 1976).

In Esfahan, antibodies against three, Nepales, Sicilian, and Karimabad, *Phlebotomus* fever virus serotypes were found from serum and blood specimen residents (Tesh *et al.*, 1976). The highest Karimabad infections rate were found in Esfahan province suggesting that the virus is endemic in this region (Tesh *et al.*, 1976) in Esfahan province.

Sand flies were first recorded by Adler, Theodor and Lourie in 1930 from Iran and until now there are 56 reported species of sand flies belonging to the genus *Phlebotomus* (subgenera *Adlerius*, *Euphlebotomus*, *Larrousius*, *Paraphlebotomus*, *Phlebotomus*, *Synphlebotomus*) and genus *Sergentomyia* (subgenera *Grassomyia*, *Parrotomyia*, *Parvidens*, *Rondanomyia*, *Sergentomyia*, *Sintonius*) (Kassiri *et al.*, 2011a; Zahraei-Ramazani *et al.*, 2015).

Initially, the fauna and distribution of Phlebotominae sand flies have been recorded from different areas of Esfahan province since 1968. Until now different studies have been done on the sand flies in this province by researchers. So, in this paper we are going to prepare a checklist of Phlebotominae sand flies species and demonstrate their geographical distribution and some important notes of them by not only field work but also literature review of all articles that have been published from different areas of this province.

## Materials and Method

### Study area:

Esfahan province with population of 4815863 (Ostandari Esfahan, 2012) is located in central Iran between 30° 42 ' and 34° 30' N latitudes and 49° 36 ' and 55° 32 ' longitudes. It consists of

mountains and plains, with an average elevation of 1600 m. It is in an area of approximately 107029 square kilometers (SCI, 1965c; Ostandari Esfahan, 2012; IRIMO, 2012). The province is bounded by Markazi, Qom, and Semnan provinces in North, Lorestan province in West, Kohkiluyeh and Boyer-Ahmad and Fars provinces in South, Yazd in East, and Chahar mahalobakhtiari and Khuzestan in Southwest. The center of the province is Esfahan city (Figure 1).

Esfahan province can be divided into three topographic and climatic regions based on their distance from the Zagros mountains in the west and the great desert in the East; (1) semi-humid and cold areas encompassing western and southern valleys; (2) the arid areas along the edge of the central desert; (3) the semi-arid region of the oasis of Esfahan marked by a moderate climate and four distinct seasons. Relative humidity varies between 25 and 62 percent (Ministry of Agricultural Jihad, 2012) (Table 1, Figure 1).

### **Sand flies collection:**

Sand flies were collected from outdoor of 10 different stations of Natanz, Mobarakeh, Shahreza, and Esfahan city areas of Esfahan province using sticky paper traps (castor oil coated white papers 15×21 cm<sup>2</sup>) during their seasonal activity in 2006 to 2013. Traps were installed before sunset and collected before sunrise. Collected sand flies were removed from sticky papers using needle dipped and stored in 96% ethanol for the purpose of morphological studies.

### **Mounting:**

The head and genitalia of individual sand flies were cut off within a drop of ethanol on a clean slide then they transferred to a drop of puri's media between a slide and cover slip (Smart *et al.* 1965). Identification of specimens was done with the available taxonomic keys (Theodor & Mesghali, 1964; Artemiev, 1978; Lewis, 1982; Seyedi-Rashti & Nadim, 1992).

### **Literature review:**

Also simultaneously the literature review was done on all published reports which have been done by the researchers on *Phlebotomine* sand flies in Esfahan province during 1968 to 2013.

## **Results**

In the last field research, a total of 716 adults sand fly were collected. 53.4% of the specimens were belonging to *Phlebotomus* genus species while 46.6% were belonging to *Sergentomyia* genus species (Zahraei Ramazani *et al.*, 2015).

The result of our literature review on the *Phlebotominae* sand flies vectors in Esfahan province shows that Nadim *et al.* (1968) were the first researchers who studied on fauna of sand flies in the different area of this province (Esfahan, Fereidan, Ardestan, Naein, Shahreza, Najafabad). Baghaei *et al.* (1996) worked and published in Persian on the fauna of Rodashtein area (along the Zayandeh Road River from Esfahan city to the Ghave Khoni Swampland). Yaghoobi & javadian *et al.* (1997) worked on the fauna of Borkhar area, Yaghoobi *et al.* (1998) studied on fauna of Ardestan area, Eshghi (1998) did his MSc thesis on fauna of Shahreza area (Full text in Persian), Yaghoobi & Akhavan *et al.* (1999) studied on the fauna of Natanz area, Yaghoobi *et al.* (2001) found the fauna of Jarghoyeh (Full text in Persian), Zahraei Ramazani *et al.* (2006) worked on the fauna of Esfahan city, Abdoli *et al.* (2007) studied on the fauna of Kuhpayeh area, Emami and Yazdi (2008) worked on the fauna of Shahreza, and Emami *et al.* (2009) found the fauna of Mobarakeh. In the latest research on vectors of leishmaniasis leading to identify the *P.(Adlerius) kabulensis* species as a new record for city of Natanz and Iran country (Zahraei Ramazani *et al.*, 2015).

As a result of prepare a checklist of the *Phlebotomine* sand flies in Esfahan province, taxonomic position, geographical distribution (Figure 1), and some notes on importance of each species are given in the present paper.

So during this field study and the result of the review articles, 170380 adult sand flies were identified and a total of 28 species of sand flies representing 9 subgenus (5 subgenus of *Phlebotomus* genus and 4 subgenus of *Sergentomyia* genus) have been recorded in collections made in 12 areas in this province. These species are listed below in alphabetical order of genera and then species, and information on their geographic distribution, climatic and temperature variation is summarized in the 3 tables and illustrated in one Figure.

#### **Checklist of *Phlebotomine* sand flies recorded in Esfahan province:**

1- Genus *Phlebotomus* Rondani and Berte, 1840

A) Subgenus *Adlerius* Nitzulescu 1931.

1- *P. brevis* Theodor and Mesghali, 1964

Distribution: Kashan (Niasar).

Note: Not investigated but it can be suspected as a potential vector of VL. It is suspected vector of *L. infantum* in Kazakhstan (Sadlova *et al.*, 2003).

2- *P. halepensis* Theodor, 1958

[*Phlebotomus (Adlerius) chinensis* Theodor 1958].

Distribution: Kashan (Niasar), Natanz, Fereidan, Shahreza.

Note: It appears to be a vector of *L. donovani* in Gruzija and possibly in Turkestan and was considered to be a main vector in Transcaucasia, Central Asia and Kazakhstan (Lewis, 1982). It can be vector of *L. infantum* in Georgia and Syria (WHO, 2010).

3- *P. kabulensis* Artemiev, 1978

Distribution: Natanz.

Note: It can be endophilic species. It can be suspected as a potential vector of visceral leishmaniasis in Afghanistan (Kabul, Gorbant, and Kandahar) (Seccombe *et al.* 1993; Artemiev, 1978).

4- *P. longiductus* Parrot, 1928

Distribution: Kashan (Niasar).

Note: It is an endophilic species in central Asia. It is vector of *L. donovani* in China and also vector of *L. infantum* in Kazakhstan, Kyrgyzstan, Ukraine and Uzbekistan (WHO, 2010).

B) Subgenus *Larroussius* Nitzulescu 1931.

5- *P. kandelaki* Shurenkova, 1929

Distribution: Esfahan, Kashan (Ghamsar, Niasar), Natanz, Fereidan, Shahreza, Kuhpayeh, Borkhar.

Note: In Afghanistan it bites man and large number animals. It appears to be a vector of *L. infantum* in Iran, Armenia, Azerbaijan and Georgia (WHO, 2010). It is naturally infected with *Leishmania* spp. promastigotes in northwest Iran and suspected as being probable vector of VL in the region (Rassi, 2005).

6- *P. keshishiani* Schurenkova, 1936

Distribution: Shahreza.

Note: It bites man in Afghanistan (Artemiev, 1978). It is naturally infected with *Leishmania* spp. promastigotes in Fars province and flagellates from them could infect a hamster so it is a probable vector of the infantile type of VL in Iran (Seyedi-Rashti, 1995).

7- *P. major* Annandale, 1910

Distribution: Kashan (Ghamsar, Niasar, Hasanabad), Natanz, Shahreza, Kuhpayeh, Naein, Borkhar, Ardestan.

Note: It is one of the principal carriers of VL in the Eastern Mediterranean (WHO, 2010). In Iran it has been found in all area where human cases of VL have been reported and also natural promastigote infection of this species has reported in endemic focus VL in Ghir (Fars province) South of Iran (Sahabi et al., 1992).

8- *P. tobbi* Addler, Theodor and Lourie, 1930

Distribution: Kashan (Ghamsar, Niasar, Barongh, Stark, Sarenj, Dorreh).

Note: It is a vector of VL (Lewis, 1982) and distributed in the Eastern Mediterranean area (Theodor and Mesghali, 1964) and probably in Transcaucasia and is a vector in Albania, Croatia, Cyprus, Greece, Israel, Palestine, Syria and Turkey (WHO, 2010).

C) Subgenus *Paraphlebotomus* Theodor 1948.

9- *P. alexandri* Sintoni, 1928

Distribution: Esfahan, Kashan (Niasar, Brongh, Aliabad), Natanz, Najafabad, Shahreza, Mobarakeh, Kuhpayeh, Ardestan, Naein, Borkhar.

Note: It bites man readily in Afghanistan (Artemive, 1978). It is a vector of *L. infantum* in China, Oman and Turkey and it transmits *L. donovani* in Iraq (WHO, 2010). Also it has been found naturally infected with promastigotes and is suspected vector of VL in Iran (Azizi et al., 2006).

10- *P. anderjevi* Shakirzyanova, 1953

Distribution: Shahreza.

Note: In the former U.S.S.R and in China, it plays a major part in disseminating *L. major* (Lewis, 1982).

11- *P. caucasicus* Marzinovski, 1917

Distribution: Esfahan, Natanz, Najafabad, Shahreza, Jarghoyeh, Kupayeh, Borkhar, Ardestan, Naein.

Note: It was considered to transmit VL in central Asia and Kazakhstan and it plays a major part in disseminating *L. major* in the former U.S.S.R (Lewis, 1982). This species was found naturally infected with *L. major* MON26 in Esfahan province (Yaghoobi-Ershadi et al., 1994). This species was also found naturally infected with promastigotes in a new focus of VL in north-west of Iran (Rassi et al., 2004).

12- *P. jacusieli* Theodor, 1947

Distribution: Kashan (Aliabad), Najafabad.

Note: It is not known to transmit leishmaniasis.

13- *P. kazeruni* Theodor and Mesghali, 1964

Distribution: Shahreza, Borkhar.

Note: It is originally reported from Iran. It has not previously been reported to bite human and role in transmission of leishmaniasis is not investigated (Artemiv, 1978).

14- *P. mongolensis* Sinton, 1928.

Distribution: Najafabad, Shahreza, Mobarakeh, Jarghoyeh, Kuhpayeh, Borkhar.

Note: It is vector of ACL in Afghanistan (WHO, 1984) and ZCL in Kazakhstan (WHO, 2010). Nadim and Rashti (1971) found this fly naturally infected with flagellates in gerbil burrows in Iran.

15- *P. sergenti* Parrot, 1917.

Distribution: Esfahan city, Kashan (Kashan city, Aranobidghole, Ghamsar, Niasar, Barongh, Srark, Sarenj, Doreh, Fin, Hasanabad, Abozeiabab, Aliabad), Natanz, Fereidan, Najafabad, Shahreza, Mobarakeh, Jarghoyeh, Kuhpayeh, Borkhar, Ardestan, Naenin.

Note: It is a vector of *L.tropica* in Iran and 17 other countries in old world and also *P.sergenti* is vector of *L.aethiopica* in Ethiopia (WHO, 2010).

In an endemic focus of ACL in Iran, *P.sergenti* was found to be predominant species through the entire period of activity. The greatest risk of ACL transmission to human in Esfahan city occurs probably during the second peak when porous rate and density of this fly remain high (Zahraei-Ramazani *et al.* 2007; Zahraei-Ramazani *et al.* 2008).

D)Subgenus *Phlebotomus* Rondani and Berte 1840.16- *P. papatasi* Scopoli, 1786.

Distribution: Esfahan city, Kashan (Kashan city, Aranobidghol, Niasar, Stark, Sarenj, Dorreh, Fin, Hasanabad, Abozeidabad, Aliabad), Natanz, Fereidan, Najafabad, Shahreza, Mobarakeh, Jarghoyeh, Kuhpayeh, Borkhar, Ardestan, Naenin.

Note: It is the main vector of *L.major* from animals to man in central Asia and appears to be the vector of *L.major* in Iran and 21 other countries in old world (WHO, 2010).The isolation and isoenzyme characterization of *L.major* (Mon-26) has been done from *P.papatasi* in Borkhar and Natanz areas in this province (Yaghoobi-Ershadi *et al.* 2005; Yaghoobi-Ershadi *et al.* 1995). This species is a troublesome biter. In view of the wide-spread distribution of *P.papatasi* and the frequency of leishmaniasis in many areas of Iran , It might suspect that human infection with sandfly- transmitted viruses is common(Tesh *et al.* 1976).

17- *P. salehi* Mesghali, 1965.

Distribution: Mobarakeh.

Note: It is vector of *L.major* in Iran, Pakistan and India (WHO, 2010). Promastigote infection of *P.salehi* is reported from Chabahar, Iran (Kassiri *et al.* 2011a).

E)Subgenus *Synphlebotomus* Theodor 1948.18- *P. ansarii* Lewis, 1957.

Distribution: Kashan (Ghamsar,Niasar), Natanz, Fereidan, Najafabad, Shahreza, Jarghoyeh, Kuhpayeh, Borkhar, Ardestan.

Note: *P.ansarii* has been found infected with flagellates in gerbil burrows in Iran (Nadim and Rashti, 1971) and It seems that this sand fly can attack human beings and suspected secondary vector of *L.major* (Artemiv, 1978).

2-Genus *Sergentomyia* Franca and Parrot 1920.A)Subgenus *Parrotomyia* Theodor 1958.19- *S. baghdadis* Adler and Theodor, 1929.

Distribution: Esfahan city, Shahreza.

Note: Sometimes numerous in human houses. Feeding habits and relation reptilian leishmaniasis as in *S.babu*(Artemiv, 1978).

20- *S. grekovi* Khodukin, 1929.

Distribution: Natanz.

Note: Females prefer to suck blood of reptiles and birds. It is the vector of reptilian leishmaniasis(Artemiv, 1978).

21- *S. palestinensis* Adler and Theodor, 1927

Distribution: Kashan (Niasar, Barongh), Natanz, Shahreza, Ardestan.

Note: Biting habits and role in transmission of reptilian leishmaniasis probably as in other species of the genus *Sergentomyia* (Artemiev, 1978).

22- *S. sumbarica* Perfiliev, 1933

Distribution: Ardestan.

Note: Biting habits and role in transmission of reptilian leishmaniasis probably as in other species of the genus *Sergentomyia*.

B) Subgenus *Rondanomyia* Theodor, 1958.

23- *S. povlovskyi* Perfiliev, 1933

Distribution: Esfahan city, Kashan (Niasar, Barongh, Dorreh), Natanz, Fereidan, Shahreza, Mobarakeh, Kuhpayeh, Ardestan, Borkhar.

Note: Biting habits seems to be as in *S. hodgsoni* that prefer to suck blood of birds and reptiles and their possibility to suck human blood is not investigated (Theodor & mesghali, 1964; Artemiev, 1978).

C) Subgenus *Sergentomyia* S.Str.

24- *S. dentata* Sinton, 1933

Distribution: Esfahan city, Kashan (Kashan city, Aranobidghol, Ghamsar, Niasar, Barongh, Stark, Sorenj, Fin, Hasanabad), Natanz, Fereidan, Shahreza, Mobarakeh, Kuhpayeh, Borkhar, Naein.

Note: Biting habits and relation to leishmaniasis like other species of the genus *Sergentomyia* (Artemiev, 1978). The presence of promastigote infection in this species and a high population of lizards in the Ardabil province indicate that it can be a vector of lizard leishmaniasis (Rassi et al., 1997).

25- *S. sintoni* Pringle, 1953

Distribution: Esfahan city, Kashan (Kashan city, Aranobidghol, Ghamsar, Barongh, Stark, Saranj, Dorreh, Fin, Hasanabad, Abozeidabad, Aliabad), Natanz, Najafabad, Shahreza, Mobarakeh, Jarghoyeh, Kuhpayeh, Borkhar, Ardestan, Naein.

Note: Infection of *S. sintoni* was observed in Mashhad, Khuzistan, Bakran, Shahrood, Varamin, Turkeman-Sahara (Seyedi-Rashti et al., 1994).

D) Subgenus *Sitonius* Nitzulescu 1931.

26- *S. christophersi* Sinton, 1927

Distribution: Mobarakeh.

Note: Biting habits poorly investigated, but it seems to be similar to *S. clydei* that prefer to suck blood of lizards, but sometimes they attack mammals and even human beings. One of the main vectors of reptilian leishmaniasis (Artemiev, 1978).

27- *S. clydei* Sinton, 1928

Distribution: Esfahan city, Kashan (Barongh, Dorreh, Abozeidabad).

Note: Javadian et al. (1982) collected this species sand fly from rodent and lizard burrows. Promastigotes were found in *S. clydei* in Lotf-Abad, Iran (Mesghali et al., 1967).

28- *S. tiberiadis* Adler, Theodor and Lourie, 1930.

Distribution: Kashan (Niasar), Natanz.

Note: Feeding habits of this species have not investigated (Artemiev, 1978).

Table 1- The geographic, climatic and temperature variation in different areas of *Phlebotominae* sand flies fauna in Esfahan Province

Area Data	Esfahan city	Kashan	Natanz	Fereidan	Najafabad	Shahreza	Mobarakeh	Jarghoyeh	Kuhpayeh	Borkhar	Ardestan	Naein
Latitude(N)	32° 37'	33° 59'	33° 32'	32° 58'	32° 38'	31° 59'	32° 21'	32° 24'	32° 43'	32° 40'	33° 22'	32° 51'
Longitude(E)	51° 40'	51° 27'	51° 54'	50° 25'	51° 22'	51° 50'	51° 30'	52° 37'	52° 26'	51° 52'	52° 24'	53° 05'
Elevation	1550.4	982.3	1684.9	2390	1650	1845.2	1670	1250	1750	1543	1381	1549
Monthly Total of Precipitation (mm)	122.8	138.4	195.3	350	153.5	144	150	760	110	107.6	112.3	98.7
Average of Minimum Temperature( C°)	9.1	12.1	10.7	4.4	6.2	7	11	6.9	6.7	6	10	9.8
Average of Maximum Temperature( C°)	23.4	26.1	20.2	17.3	12.8	22.3	26.3	24.2	23.9	23.9	25	23.4

Table 2- Distribution of various species of Genus *Phlebotomus* sand flies in different areas of the province of Esfahan

Area Sand fly Species	Esfahan city	Kashan	Natanz	Fereidan	Najafabad	Shahreza	Mobarakeh	Jarghoyeh	Kuhpayeh	Borkhar	Ardestan	Naein
<i>P.papatasi</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>P.sergenti</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>P.caucasicus</i>	+	-	+	-	+	+	-	+	+	+	+	+
<i>P.mongolensis</i>	-	-	-	-	+	+	+	+	+	+	-	-
<i>P.kandelakii</i>	+	+	+	+	-	+	-	-	+	+	-	-
<i>P.anderjevi</i>	-	-	-	-	-	+	-	-	-	-	-	-
<i>P.ansarii</i>	-	+	+	+	+	+	-	+	+	+	+	-
<i>P.major</i>	-	+	+	-	-	+	-	-	+	+	+	+
<i>P.alexandri</i>	+	+	+	-	+	+	+	-	+	+	+	+
<i>P.kazeruni</i>	-	-	-	-	-	+	-	-	-	+	-	-
<i>P.jacuseli</i>	-	+	-	-	+	-	-	-	-	-	-	-
<i>P.halepensis</i>	-	+	+	+	-	+	-	-	-	-	-	-
<i>P.brevis</i>	-	+	-	-	-	-	-	-	-	-	-	-
<i>P.tobbi</i>	-	+	-	-	-	-	-	-	-	-	-	-
<i>P.longiductus</i>	-	+	-	-	-	-	-	-	-	-	-	-
<i>P.salehi</i>	-	-	-	-	-	-	+	-	-	-	-	-
<i>P.keshishiani</i>	-	-	-	-	-	+	-	-	-	-	-	-
<i>P.kabulensis</i>	-	-	+	-	-	-	-	-	-	-	-	-

Table 3- Distribution of various species of Genus *Sergentomyia* sand flies in different areas of the province of Esfahan

Sand fly Species \ Area	Esfahan city	Kashan	Natanz	Fereidan	Najafabad	Shahreza	Mobarakeh	Jarqhoeyeh	Kuhpayeh	Borkhar	Ardestan	Na'in
<i>S. sintoni</i>	+	+	+	-	+	+	+	+	+	+	+	+
<i>S. dentata</i>	+	+	+	+	-	+	+	-	+	+	-	+
<i>S. povlovskyi</i>	+	+	+	+	-	+	+	-	+	+	+	-
<i>S. clydei</i>	+	+	-	-	-	-	-	-	-	-	-	-
<i>S. sumbarica</i>	-	-	-	-	-	-	-	-	-	-	+	-
<i>S. palestiansis</i>	-	+	+	-	-	+	-	-	-	-	+	-
<i>S. baghdadis</i>	+	-	-	-	-	+	-	-	-	-	-	-
<i>S. grekovi</i>	-	-	+	-	-	-	-	-	-	-	-	-
<i>S. tiberiadis</i>	-	+	+	-	-	-	-	-	-	-	-	-
<i>S. christophersi</i>	-	-	-	-	-	-	+	-	-	-	-	-

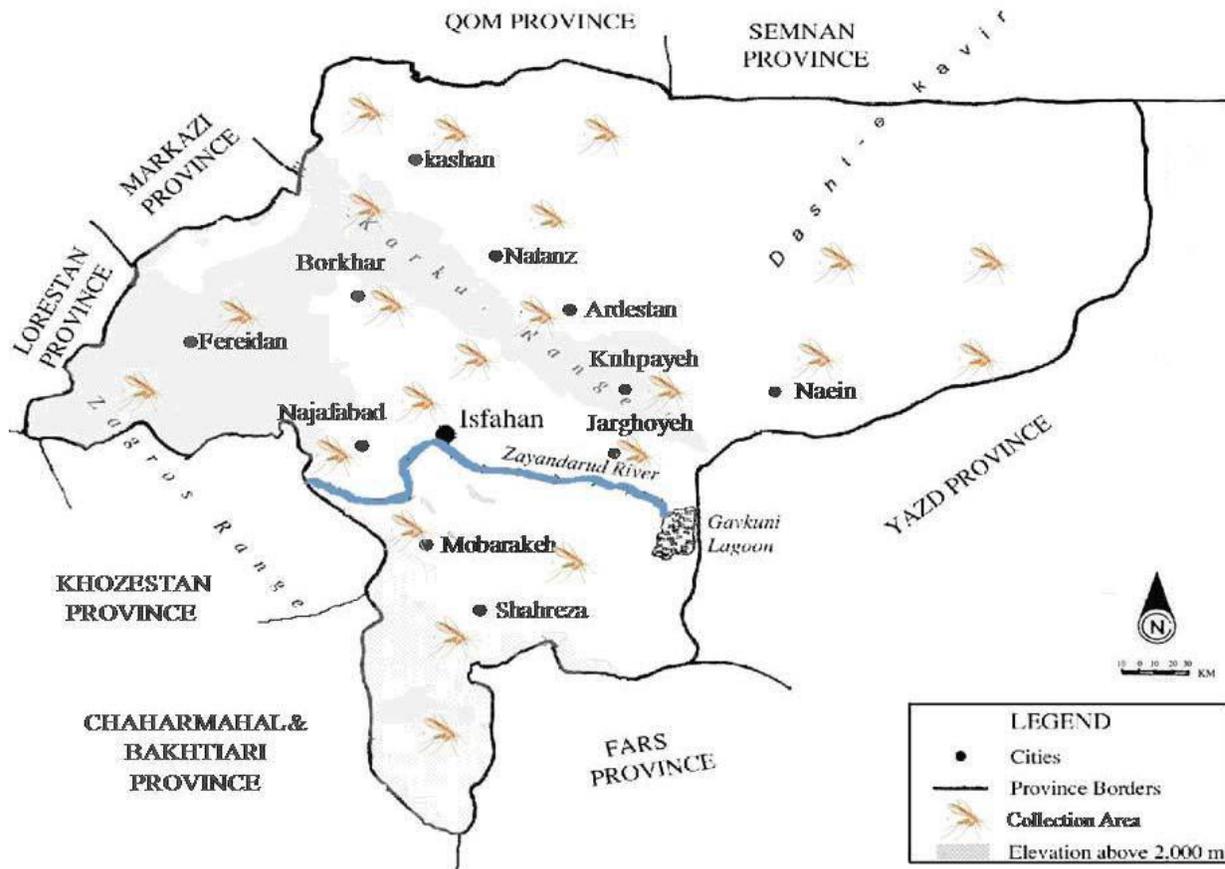


Fig. 1- Geographical distribution and areas of *Phlebotominae* sand fly collection in Esfahan province

## Conclusion

The geographical distribution of each 28 species of sand flies in Esfahan province and some important notes of them is demonstrated in this article.

*Phlebotomus papatasi* as the main vector of zoonotic cutaneous leishmaniasis and arboviruses and also *P. sergenti* as the main vector of anthroponotic cutaneous leishmaniasis were collected from all areas of this province. Also *P. alexandri*, *P. major*, *P. kandelaki* and *P. keshishiani* as suspected vectors of visceral leishmaniasis in Iran were found in this province.

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## چک لیست و توزیع جغرافیایی پشه خاکی‌های فلیبوتومینه (Psychodidae :Diptera) ناقلین لیشمانیوزها در استان اصفهان، ایران

علیرضا زهرایی رضائی<sup>۱\*</sup>، محمد مهدی صداقت<sup>۲</sup>

۱- استادیار، گروه حشره‌شناسی پزشکی و مبارزه با ناقلین، دانشکده بهداشت و انستیتو تحقیقات بهداشتی، دانشگاه علوم پزشکی تهران  
۲- دانشیار، گروه حشره‌شناسی پزشکی و مبارزه با ناقلین، دانشکده بهداشت و انستیتو تحقیقات بهداشتی، دانشگاه علوم پزشکی تهران

### چکیده

پشه خاکی‌های فلیبوتومینه ناقلین انواع لیشمانیوزها و آربوویروس‌ها به انسان می‌باشند. سه نوع لیشمانیوز جلدی روستایی، جلدی شهری و نیز احشایی در استان اصفهان وجود دارد. همچنین آنتی بادی‌های ضد سه نوع آربوویروس نپال، سیسیل و کریم آباد در خون و سرم ساکنین این استان یافت می‌شود. هدف از این مطالعه تهیه فهرستی کامل از پشه خاکی‌های فلیبوتومینه و نیز توزیع جغرافیایی آن‌ها در استان اصفهان می‌باشد. در مطالعه صحرایی، پشه خاکی‌ها توسط تله چسبان از ۱۰ مکان مختلف در نطنز، مبارکه، شهرضا و نیز شهر اصفهان، استان اصفهان طی سال‌های ۱۳۸۵ تا ۱۳۹۲ جمع‌آوری گردیدند. به‌علاوه با مطالعه کتابخانه‌ای و مراجعه به کلیه مقالات و نوشته‌های محققین مختلف فهرستی از گونه‌های پشه خاکی گزارش شده طی سال‌های ۱۳۴۷ تا ۱۳۹۲ شناسایی و یادداشت گردید. در کل از تعداد ۱۷۰۳۸۰ نمونه پشه خاکی صید شده از این استان، تعداد ۲۸ گونه گزارش شده است. پشه خاکی *Phlebotomus papatasi* ناقل قطعی لیشمانیوز جلدی روستایی و آربوویروسها به‌علاوه پشه خاکی *Phlebotomus sergenti* ناقل لیشمانیوز جلدی شهری از تمام مناطق استان اصفهان صید گردیده است. همچنین پشه خاکی‌های *P. major*، *P. kandelaki* (احتمالاً *P. neglectus*)، *P. keshishiani* و نیز *P. alexandri* ناقلین لیشمانیوز احشایی در ایران نیز از استان اصفهان صید شده‌اند. انتشار جغرافیایی این ۲۸ گونه پشه خاکی و نیز برخی از یادداشت‌های مهم از آن‌ها در این مقاله آورده شده است.

واژه‌های کلیدی: چک لیست، انتشار، پشه خاکی‌های فلیبوتومینه، استان اصفهان

\* نویسنده رابط، پست الکترونیکی: [alirezazahraei@yahoo.com](mailto:alirezazahraei@yahoo.com)

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