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

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**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, Mobarak, Shahreza and Esfahan city areas of Esfahan province during 2006 to 2013. Also literature review was done on all publish 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. sergentii* 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

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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 (Tabatabai 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, Larrousia, Paraphlebotomus, Phlebotomus, Synphlebotomus) and genus Sergentomyia (subgenera Grassomyia, Parrotomyia, Parvidens, Rondonomyia, 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 mahalobakhtiar 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 Jahad, 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 cm²) 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 preparing 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
      
      Distribution: Kashan (Niasar), Natanz, Fereidan, Shahreza.
      
      Note: It appears to be a vector of L. donovani in Gruziya 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, Gorband, 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 areas where human cases of VL have been reported and also natural promastigote infection of this species has been 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, Brongh, 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, Mobarakbeh, 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, Mobarakheh, Jarghoyeh, Kupayeh, 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, Abozeidadbad, Aliabad), Natanz, Fereidan, Najafabad, Shahreza, Mobarakheh, Jarghooyeh, Kuhpayeh, Borkhar, Ardestan, Naein.

Note: It is a vector of *L.tropica* in Iran and 17 other countries in old world and also *P.sergenti* is vector of *Laethiopica* 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, Mobarakheh, Jarghooyeh, Kuhpayeh, Borkhar, Ardestan, Naein.

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).


Distribution: Mobarakheh.

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.


Distribution: Kashan (Ghamsar, Niasar), Natanz, Fereidan, Najafabad, Shahreza, Jarghooyeh, 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.


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.


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: Kashan (Kashan city, Aranobidghol, Ghamsar, Barongh, Stark, Saranj, Dorreh, Fin, Hasanabad, Abozeidadab, Aliabad), Natanz, Najafabad, Shahreza, Mobarakeh, Jarghoyeh, Kuhpayeh, Borkhar, Ardestan, Naein.
   Note: Infection of *S.sintoni* was observed in Mashhad, Khuzistan, Bakran, Shahrood, Varamin, Turkemn-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, Abozeidadab).
   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

<table>
<thead>
<tr>
<th>Area</th>
<th>Data</th>
<th>Esfahan city</th>
<th>Kashan</th>
<th>Natanz</th>
<th>Fereidan</th>
<th>Najafabad</th>
<th>Shahreza</th>
<th>Mobarakh</th>
<th>Jarghoyeh</th>
<th>Kuhpayeh</th>
<th>Borkhar</th>
<th>Ardestan</th>
<th>Naen</th>
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<tbody>
<tr>
<td>Latitude(N)</td>
<td></td>
<td>32° 37'</td>
<td>33° 59'</td>
<td>33° 32'</td>
<td>32° 38'</td>
<td>31° 59'</td>
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<td>32° 40'</td>
<td>33° 22'</td>
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<tr>
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<td>51° 54'</td>
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<td>52° 26'</td>
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<td>982.3</td>
<td>1684.9</td>
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<td>1650</td>
<td>1845.2</td>
<td>1670</td>
<td>1250</td>
<td>1750</td>
<td>1543</td>
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<tr>
<td>Monthly Total of Precipitation (mm)</td>
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<td>195.3</td>
<td>350</td>
<td>153.5</td>
<td>144</td>
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<td>760</td>
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<td>Average of Minimum Temperature (°C)</td>
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<td>23.9</td>
<td>23.9</td>
<td>25</td>
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Table 2- Distribution of various species of Genus *Phlebotomus* sand flies in different areas of the province of Esfahan

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<th>Najafabad</th>
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<th>Mobarakh</th>
<th>Jarghoyeh</th>
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<tr>
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<td>-</td>
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<td><em>P. mongolensis</em></td>
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Table 3- Distribution of various species of Genus *Sergentomyia* sand flies in different areas of the province of Esfahan

<table>
<thead>
<tr>
<th>Sand fly Species</th>
<th>Area</th>
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<th>Natanz</th>
<th>Fereidan</th>
<th>Najafabad</th>
<th>Shahreza</th>
<th>Mobarakeh</th>
<th>Jarghoyeh</th>
<th>Kuhpayeh</th>
<th>Borkhar</th>
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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 arbovirous and also *P. sergenti* as the main vector of anthropotonic 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.

Acknowledgment
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SCI (Statistical Center of Iran) 1965. Vice-Presidency for Strategic planning and supervision.


چک لیست و توزیع چترپای‌ها به‌خاکی‌های فلیبوتومینه
ناقلین لیشمانیوزها در استان اصفهان، ایران

(Psychodidae : Diptera)

علمی- پژوهشی
(علوم پزشکی)

جلد ۷، شماره ۲، سال ۱۳۹۴ (۶۹-۸۲)

چکیده
پشه‌های خاکی‌های فلیبوتومینه ناقلین انواع لیشمانیوزها و آربوپرسوس ها به‌خاکی می‌باشند. سه نوع لیشمانیوز جنگلی روتستایی، جنگلی شهری و نیز احتمالی در استان اصفهان وجود دارد. همچنین آنتی‌بادی‌های ضد سه نوع آربوپرسوس نیال، سیله‌سنگ و کرم آباد در خون و سرم ساکت‌های این انسان‌های پاتنتی می‌شود. هدف از این مطالعه تهیه فهرستی کامل از پشه‌های خاکی‌های فلیبوتومینه و نیز توزیع چترپای‌های آن‌ها در استان اصفهان می‌باشد. در مطالعه صحراپایی، پشه‌های کیوچ خاکی‌ها توسط نله چسبان از ۱۰ مکان مختلف در نطنز، مبارکه، شهرضا و نیز شهر اصفهان استان اصفهان تهیه گردیدند. هم‌علاوه‌به مطالعه کتابخانه‌ای و مراجعت به کلیه مقالات و نوشتارهای محققین مختلف فهرستی از گونه‌های پشه‌های خاکی گزارش شد که در سال‌های ۱۳۸۵ تا ۱۳۹۴ شناسایی و به‌داده‌شده توده که در کل از تعداد ۱۷۰۸۰ نمونه پشه‌های خاکی صید شده از این استان، تعداد ۲۸ گونه گزارش شده است. پشه‌های خاکی ناکل قطعی لیشمانیوز جنگلی روتستایی و آربوپرسوس Phlebotomus papatasii به‌علاوه پشه‌های ناکل لیشمانیوز جنگلی شهری از تمام مناطق استان اصفهان صید گردیده است. همچنین پشه‌های خاکی‌های و نیز تهیه‌ها (احتمالاً P. alexandri، P. keshishianii، P. neglectus، P. major و P. kandelaki) در اصفهان احتمالی در ایران نیز از استان اصفهان صید شده‌اند. انتشار چترپای‌ها در این استان اصفهان به‌شکل گزارش شده است.

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

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