



**SURVEY OF THE MAIN VECTORS OF LEISHMANIASIS, FAUNA OF  
PHLEBOTOMINE SAND FLIES (DIPTERA: PSYCHODIDAE) IN ALBORZ PROVINCE,  
IRAN**

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**ABSTRACT**

**Introduction:** Leishmaniasis is a predominantly rural disease with multifaceted clinical manifestations caused by infections with species of *Leishmania*. Sand flies are the only vectors of the various species of leishmaniasis. There are several reports on outbreaks of cutaneous and visceral leishmaniasis in the rural areas of Alborz Province. This study was aimed to determine of the vector(s) and monthly activity of sand flies in Alborz Province. **Materials & Methods:** Collection of sand flies were done from villages of districts of Alborz province. Sand flies were caught (outdoor and indoor places) by sticky papers from the late April and continued until the end of November, 2015. Temperature and relative humidity of collected places were registered. **Results:** Altogether 3040 specimens comprising 13 species (11 *phlebotomus* and 2 *Sergentomyia*) were collected and identified. Among the collected sand flies. Sex ratio of total catches of sand flies were calculated 4.23. Two species of *P. sergenti* and *P.tobbi* with a frequencies of 45.9% and 27.6% were dominant specimens respectively. The average temperature of indoors and outdoors places were calculated 21.7°C and 20°C respectively. The average relative humidity in indoors and outdoors were 50% and 51% respectively. **Discussion:** Our results demonstrate the existence of important vector species of sand flies in the Alborz province, Iran. *P. sergenti* and *P.tobbi* with a height frequencies were dominant and important specimens in rural areas in Alborz province. It seems this two species are playing the principal role in circulating of *Leishmania parasites* between host reservoirs and human in rural areas of this region. Further studies should focus on *P. tobbi* and *P. sergenti* to confirm if the sand flies species transmitting CL and VL in this region.

**KEYWORD:** Sand fly, fauna, Leishmaniasis, CL, VL, Alborz province.

**INTRODUCTION**

Phlebotomine sand flies (Diptera: Psychodidae) are the main vectors of Leishmaniasis, and species of the genus *Phlebotomus* are the only known vectors in the Old World.<sup>[1]</sup> There are two forms of leishmaniasis in Iran, VL (Visceral Leishmaniasis) and CL (Cutaneous Leishmaniasis).<sup>[2]</sup> The most prevalent leishmaniasis in the world is CL.<sup>[3]</sup> In the Old World, two sand flies, *Phlebotomus papatasi* and *Phlebotomus sergenti* are recognized as the main vector of CL.<sup>[2]</sup> Of nearly 900 sand fly species in the world, about 50 have been concerned as vectors of leishmaniasis<sup>[4]</sup> and<sup>[5]</sup> There are at least 44 species of sand flies (26 of the genus *Phlebotomus* and 18 of genus *Sergentomyia*) in Iran.<sup>[6]</sup>

Species of *Sergentomyia* feed predominantly on reptiles, but the *Phlebotomus* feed mainly on mammals.<sup>[7]</sup> Of the 15 known species of *Leishmania* parasites that cause diseases in humans, 13 are common between both humans and animals that contain VL, CL and Mucocutaneous Leishmaniasis pathogens in the old and new world. In the Middle East, CL is mainly caused by *leishmania major* and *leishmania tropica*<sup>[8]</sup> and.<sup>[9]</sup> CL is endemic in few provinces in Iran including Fars, Isfahan, Kerman, Yazd and Khorasan<sup>[10]</sup> and.<sup>[14]</sup> *Leishmania infantum* (*L. infantum*), belonging to the *Leishmania donovani* (*L. donovani*) complex, is the causative agent of VL, cutaneous and canine VL in all of Mediterranean countries. The disease is zoonotic and transmitted to

humans from its reservoir hosts, mainly dogs by the bite of sand fly of genus *Phlebotomus*<sup>[5]</sup> and.<sup>[15]</sup> VL in Iran is endemic in six provinces including East Azerbaijan, Ardebil, Fars, Bushehr, North Khorasan and Kerman<sup>[16]</sup>,<sup>[17]</sup>,<sup>[18]</sup>,<sup>[19]</sup> and.<sup>[20]</sup>

## MATERIALS AND METHODS

### a) Study area

Alborz province is located in north of Iran and has an area of 5174 km<sup>2</sup> (Fig 1). The total population of the Alborz province was about 2642000 in 2015. The study was carried out in Alborz province, located 30 kilometers of Tehran, the capital city of Iran. Alborz province is situated at 35° 28' to 36° 30' N and 50° 10' to 51° 30' E. There are 6 districts in Alborz province including: Karaj, Savojbolagh, Nazar Abad, Fardis, Eshtehard and Taleghan. Karaj is the capital city in Alborz province. To study fauna and frequency of sand flies, six villages of the plain areas, six villages of mountainous areas and six locations inside urban areas in Alborz province were selected.



Figure 1. The map of study area showing Alborz Province, Iran.

### a) Methods

Phlebotomine sandflies were collected biweekly by sticky paper traps (castor oil-coated white papers, 20×32 cm) from indoor and outdoor areas in April to October 2015. In each sampling, 30 sticky paper traps were set in the evening and collected in the next morning. Sand flies were mounted in Puri's mediu,<sup>[21]</sup> identified using the identification keys of Theodor and Mesghali (1964) and Lewis (1982).<sup>[22]</sup> In determining the monthly activity of sand flies, they were caught from indoor and outdoor places of the lowland and the highland locations during this period. Temperature and relative humidity of collected places were registered.

## RESULTS

A total of 3040 adult sandflies, comprising 13 species (11 *Phlebotomus* and 2 *Sergentomyia*) were collected from May to November in 2015. Sandflies were not active in January-April, and December. They were recorded in May for the first time. According to Table 1, among the collected sand flies, 80.07% were male and the rest were female. Sex ratio (number of males/females × 100) of total catches of sand flies were calculated 4.01. Two species of *P. sergenti* and *P. tobbi* with a frequencies of 45.9% and 27.6% were dominant specimens respectively. Another sand flies included *P. mongolensis* (6.28%), *P. perfiliewii* (4.93%), *P. papatasi* (3.62%), *P. keshishiani* (3.30%), *P. caucasicus* (2.70%), *P. major* (1.85%), *P. caucasicus* G. (1.38%), *P. alexandri* (1.05%), *P. kandelaki* (0.63%), *S. dentate* (0.50%), *S. pawlowskyi* (0.26%). The highest (33.5%) and lowest (1.2%) number of sand flies were collected in August and November respectively. 54.44% of sand flies collected were in mountain areas and 45.56% collected were in land areas (Table 2). During the activity season of sand flies, the average temperature of indoors and outdoors places were calculated 21.7°C and 20°C respectively. The average relative humidity in indoors and outdoors were 50% and 51% respectively (Table 3).

Table 1: Fauna, abundance and percentage of *Phlebotomus* and *Sergentomyia* sand flies collected from Alborz Province, Iran (2015).

Specie	Sex ratio	Male	Female	Indoors	Outdoors	Land area	Mountain area	Total	Percent (%)
<i>Ph. sergenti</i>	2.6	1015	380	373	1022	810	585	1395	45.90
<i>Ph. tobbi</i>	6.19	714	126	455	385	215	625	840	27.60
<i>Ph. mongolensis</i>	0	191	0	53	138	135	56	191	6.28
<i>Ph. perfiliewii</i>	13.5	137	13	115	35	35	115	150	4.93
<i>Ph. papatasi</i>	5.17	88	22	46	64	72	38	110	3.62
<i>Ph. keshishiani</i>	0	100	0	66	34	23	77	100	3.30
<i>Ph. caucasicus</i>	0	82	0	28	54	52	30	82	2.70
<i>Ph. major</i>	7.5	49	7	44	12	18	38	56	1.85
<i>Ph. caucasicus</i> G.	0	0	42	37	5	9	33	42	1.38
<i>Ph. alexandri</i>	8	28	4	28	4	11	21	32	1.05
<i>Ph. kandelaki</i>	1.33	11	8	13	6	5	14	19	0.63
<i>S. dentata</i>	4.5	11	4	2	13	0	15	15	0.50
<i>S. pawlowskyi</i>	-----	8	-----	2	6	0	8	8	0.26
Total	-----	2434	606	1262	1778	1385	1655	3040	100
Percent(%)	4.01	80.07	19.93	41.5	58.5	45.56	54.44	100	100

Table 2. Monthly abundance of phlebotomine sandflies during May - November, 2015 in Alborz Province, Iran.

Species	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Total
<i>Ph. sergenti</i>	57	185	490	542	89	23	9	1395
<i>Ph. tobbi</i>	40	118	192	310	123	35	22	840
<i>Ph. mongolensis</i>	6	82	35	39	19	7	3	191
<i>Ph. perfiliewii</i>	2	15	42	54	25	12	0	150
<i>Ph. papatasi</i>	4	32	40	22	7	5	0	110
<i>Ph. keshishiani</i>	12	26	42	15	3	1	1	100
<i>Ph. caucasicus</i>	8	23	31	12	5	3	0	82
<i>Ph. major</i>	4	20	22	7	3	0	0	56
<i>Ph. caucasicus G.</i>	7	11	16	6	2	0	0	42
<i>Ph. alexandri</i>	0	8	12	7	3	1	1	32
<i>Ph. kandelaki</i>	0	5	8	3	2	1	0	19
<i>S. dentata</i>	2	3	8	1	1	0	0	15
<i>S. pawlowskyi</i>	0	1	5	1	1	0	0	8
Total	142	529	943	1019	283	88	36	3040
Percent (%)	4.7	17.4	31	33.5	9.3	2.9	1.2	100

Table 3. Climatological condition of Alborz province during sampling time in 2015.

Month		May	June	July	August	September	October	November	Average
Temperature (oC)	Indoor	20	25	28	29	21	17	12	21.7
	Outdoor	18	24	25	27	20	15	11	20
Relative humidity(%)	Indoor	58	49	42	43	45	52	61	50%
	Outdoor	55%	51%	43%	45%	45%	54%	64%	51%

## DISCUSSION

This study is the report of the results of entomology investigations on sand flies in Alborz province. The epidemiology and ecology of leishmaniasis are very important measures for management of disease control. *P. sergenti* was the predominant species of the genus *Phlebotomus* in outdoors (57.5%) and *P. tobbi* was the predominant species of the genus *Phlebotomus* in indoors (36%). The activity of the sand flies extended from May to November with one peak in August. The most level of density was related to.

August. Whereas, there was a peak of temperature in this month. In another words, the population of the sand flies dynamically was direct correlation to the temperature of the area but to the humidity. CL proven or suspected vector species present in Iran are *Ph. papatasi*, *P. sergenti*, *Ph. caucasicus*, *Ph. mongolensis*, *Ph. andrejevi*, *Ph. ansarii*, *Ph. salehi*, and VL proven or suspected vector species present in Iran are *Ph. alexandri*, *Ph. major*, *Ph. keshishiani*, *Ph. kandelakii* and *Ph. Perfiliewi*.<sup>[6]</sup> The most CL and VL vectors identified in the different parts in Alborz province. In the Alborz province proven or suspected vector species present are *Ph. papatasi*, *P. sergenti*, *Ph. caucasicus*, *Ph. mongolensis*, *Ph. alexandri*, *Ph. major*, *Ph. keshishiani*, *Ph. kandelakii* and *Ph. perfiliewi*. Bahrami et al. identified natural infection to *L. infantum* in *Ph. tobbi* in Savodjbolagh county, Alborz province<sup>[23]</sup>, it seems this species is playing principal role transmitting of *L. infantum* between dog reservoirs and human in rural areas of Alborz province north of Iran. Heidari et al. identified *Leishmania* infection using direct agglutination test (DAT) in children living in rural districts of Alborz

province.<sup>[24]</sup> Natural infection of *P. tobbi* with *L. infantum* reported in Ardebile province northeastern Iran.<sup>[25]</sup> Doroudgar et al. identified a total of 17 species of sandflies belonging to the genus *Phlebotomus* (11 species) and *Sergentomyia* (6 species) from Kashan County and *Phlebotomus papatasi* was the dominant specie (44.6%) in indoor.<sup>[26]</sup> Kassiri et al. reported a total of 17 species of sandflies belonging to the genus *Phlebotomus* (9 species) and *Sergentomyia* (12 species) from Iranshahr County and *Phlebotomus papatasi* and *P. alexandri* were the dominant species (55.7% and 25.6%).<sup>[27]</sup> Another dominant species in Alborz province was *P. sergenti* (45.9%). Natural promastigote infections have been found in this species in two ACL foci due to Mashhad and Esfahan City [28] and.<sup>[29]</sup> *Phlebotomus sergenti* was reported as *L. tropica* host by PCR in Shiraz and Kerman Cities<sup>[30]</sup> and.<sup>[31]</sup> *Phlebotomus sergenti* has a wide distribution in the most province in country that includes and in some province extends beyond the distribution of *L. tropica*. Our results demonstrate the existence of important vector species of sand flies in the study area. Further studies should focus on *P. tobbi* and *P. sergenti* to confirm if the sand flies species transmitting CL and VL in this region.

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