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Entomological study of sand flies (Diptera: Psychodidae: Phlebotominae) in Asalouyeh, the heartland of an Iranian petrochemical industry

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PEER REVIEW

Peer reviewer

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Comments

This is an ordinary article which gives useful information just on the fauna and some basic biological aspects of leishmaniasis vector (sand flies) in an important Iranian petrochemical gas field, southern Iran.
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ABSTRACT

Objective: To investigate the fauna and seasonal activity of different species of sand flies (Diptera: Psychodidae: Phlebotominae) in Asalouyeh, the heartland of an Iranian petrochemical industry, Southern Iran, as a oil rich district. Sand flies are the vectors of at least three different kinds of disease, the most important of which is leishmaniasis, and it is a major public health problem in Iran with increased annual occurrence of clinical episodes.

Methods: A total of 3 497 sand flies of rural regions were collected by sticky traps fixed, and cleared in puris medium and identified morphologically, twice a month from April to March 2008.

Results: Predominant species included four of genus *Phlebotomus* (*Phlebotomus alexandri* Sinton, 1928, *Phlebotomus papatasi* Scopoli, 1910, *Phlebotomus bergeroti* Parrot and *Phlebotomus sergenti* Parrot) and one of genus *Sergentomyia* (*Sergentomyia tiberiadis* Alder, Theodor & Lourie, 1930). The most prevalent species was *Phlebotomus papatasi*, presented 56.4% of the identified flies. The others were *Phlebotomus sergenti* (22.5%), *Phlebotomus alexandri* (4.5%), *Phlebotomus bergeroti* (12%) and *Sergentomyia tiberiadis* (5%) as well. The percentage of females (68%) was more than that of males (32%). The abundance of sand flies represented two peaks of activity; one in early May and the other one in the first half of September in the region.

Conclusion: *Phlebotomus papatasi* is the probable vector of zoonotic cutaneous leishmaniasis in the region. Further molecular studies are needed to determine the definite vector of the region.

KEYWORDS

Leishmaniasis, Sand flies, Asalouyeh, Bushehr

1. Introduction

Cutaneous leishmainasis is a global public health problem. According to the World Health Organization, cutaneous leishmainasis spreads in 88 different countries and about 12 million people are infected worldwide. Almost 350 million individuals are estimated to be exposed to the disease annually as well[1]. Cutaneous leishmainasis is also considered as an important health concern in Iran with increased annual occurrence of clinical episodes from 220 per 100 000 in 2001 to 350 per 100 000 in 2006[2]. It has been prevalent in several provinces of Iran in the recent decades[3-5].

Sand flies are the vectors of leishmaniasis and sand fly fever virus[3]. Leishmania parasites propagate in the gut of female sand fly, as the carriers of leishmania protozoa, and then are directly injected to the skin of human body[6]. However, the infection does not affect the survival of sand fly as well.

Phlebotomus sergenti (*P. sergenti*) is the only proven vector of cutaneous leishmainasis and laboratory studies have demonstrated the specialty of this species for the protozoan

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Leishmania tropica[7]. It is distributed from the Canary Islands in Spainto India[8] and is also reported in the neighbor countries including Turkey, Iran, Afghanistan, Pakistan and Turkmenistan[9].

In the past years, cutaneous leishmainasis was considered to be one of the most important endemic diseases in Shiraz, Mashhad, Isfahan and Bam in Kerman Province[5,6]. Now days, the diseases are endemic in various cities of Iran including Tehran, Kerman, Shiraz, Isfahan, Boushehr and Mashhad. The prevalence can be observed with increasing human population. In general, the prevalence of cutaneous leishmainasis has been more reported in rural than that of urban areas, and 20-29 years old people are the most susceptible age group to the disease[10].

It should be noted that uncontrolled urban development and population growth are related to sand flies. Changing housing patterns to the apartment in cities does not decrease the incidence of the diseaseamongthe inhabitantsof apartments invarious floors, especially the lowerfloors.

The purpose of the present study was to investigate the faunae and monthly activities of sand flies as the vectors of cutaneous leishmainasis. The findings are suggested to be used for the future programs of disease control in Asalouyeh.

2. Materials and methods

Asalouyeh(27°28′34″ N 52°36′27″ E) is a town of Bushehr Province, Southern Iran, which is located on the shore of the Persian Gulf, southwest of the capital of Bushehr, and is known as the site for the huge PSEEZ (Pars Special Energy Economic Zone) project (Figure 1). Population of about 60 000 inhabitants has been settled or is working in Assaluyeh and Nakhle-Taqi, mostly due to the development of South Pars gas field. Houses are built of concrete and stone in urban and suburban areas of the town.

This study was conducted using sticky paper traps at the first and fifteenth of each month, from April to March 2008, in 4 areas of Asalouyeh. A total of 60 sticky traps were installed either indoor (bedroom and bathroom) or outdoor (gardens and rodent burrows around the village). Traps were set in the holes of the garden walls, in adjacent to the rodent burrows in outdoor places.

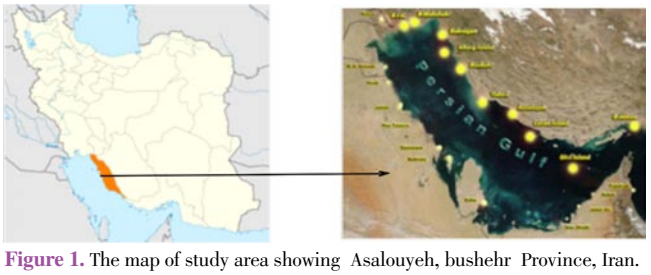

Figure 1. The map of study area showing Asalouyeh, bushehr Province, Iran.

Sticky traps (20 cm ×20 cm), coated with castor oil, were placed in each sampling location and left for one night. They were set and collected at sunset and before sunrise the next morning, respectively. Trapping at each temperature and humidity was recorded.

Sand flies were removed from the sticky traps by needle, washed by acetone in a glass containing 70% alcohol and then canned in the puri medium on the slides under the stereomicroscope.

The identification was made by examining the morphology of male genitalia, female spermatheca and pharynges using Theodor and Mesghali systemic identification key[11].

3. Results

A total of 3 497 sand flies (2 594 males and 903 females) were collected from four areas during the study (Table 1). 1 945(55.7%) and 1 552(44.3%) sand flies were hunted from indoor and outdoor regions, respectively (Table 2). After determining the species of sand flies, four species of the genus *Phlebotomus* [*Phlebotomus papatasi* (*P. papatasi*), *Phlebotomus alexandri* (*P. alexandri*), *Phlebotomus bergeroti* (*P. bergeroti*), *P. sergenti*] and one species of the genus *Sergentomyia* [*Sergentomyia tiberiadis* (*S. tiberiadis*)] were detected as active ones in the region (Table 1). Most of the specimens of *P. papatasi* (34.2%), *P. sergenti* (31.8%) and *S. tiberiadis* (32.7%) were obtained from Nakhl-taghi (Table 2).

Table 1
Species composition and relative abundance of phlebotomine sand flies in Asalouyeh, Southern Iran 2011.

Species	Male		Female		Total	
	Number	%	Number	%	Number	%
P. sergenti	524	20.2	267	29.5	791	22.5
P. papatasi	1536	59.2	420	46.5	1956	56.0
P. alexandri	99	3.8	55	6.0	154	4.5
P. Bergeroti	380	14.6	45	4.9	425	12.0
S. Tiberiadis	55	2.1	116	12.8	171	5.0
Total	2594		903		3497	100.0

In this study was observed significant difference between location and species of sand flies ($P<0.05$).

The most collected (human and animal) species of sand flies in indoor places was *P. papatasi*. It was also the most predominant species in all areas and accounted for 56% of the identified flies. 85% and 81% of human and animal species of indoor places was *P. papatasi*, respectively. The adult sex ratio was 370 males versus 100 females.

P. sergenti, consists of 22.5% of sand flies collected form Asalouyeh, and is considered to be the second abundant species of sand flies collected from the area.

In this period two peaks of activity were observed,

Table 2

The geographic and climatic information of collected sand flies in Asalouyeh, Southern Iran, 2011.

Locality	Species															ATY	AHY
	P. sergenti			*P. papatasi*			*P. alexandri*			*P. bergeroti*			*S. tiberiadis*				
	Indoor n(%)	Outdoor n(%)	Total n(%)	Indoor n(%)	Outdoor n(%)	Total n(%)	Indoor n(%)	Outdoor n(%)	Total n(%)	Indoor n(%)	Outdoor n(%)	Total n(%)	Indoor n(%)	Outdoor n(%)	Total n(%)		
Asalouyeh	69(37.2)	116(62.8)	185(23.3)	239(56.3)	145(43.7)	384(19.6)	13(38.2)	21(61.8)	34(22.0)	21(35.0)	39(65.0)	60(14.11)	11(30.5)	25(69.5)	36(21.0)	23.5	40%
Nakhl-taghi	131(51.9)	121(48.1)	252(31.8)	425(63.4)	245(36.6)	670(34.2)	29(70.7)	23.5	41(26.6)	19(17.5)	89(73.5)	108(25.4)	25(44.6)	31(63.4)	56(32.7)	23.5	40%
Shirinoo	121(61.7)	75(38.3)	196(24.7)	305(60.7)	137(39.3)	442(22.5)	30(61.2)	23.5	49(31.8)	33(8.7)	81(91.2)	114(26.8)	14(36.8)	24(63.2)	38(22.2)	23.5	40%
Bidkhoon	61(38.6)	97(61.4)	158(20.0)	312(60.0)	138(60.0)	450(23.0)	20(66.6)	23.5	30(19.4)	41(26.7)	112(33.3)	153(36.0)	24(58.5)	17(41.5)	41(23.9)	23.5	40%
Total	382(48.2)	409(51.8)	791	1291(66.0)	665(34.0)	1956	92(59.7)	62(40.3)	154	104(24.4)	321(33.6)	425	74(43.2)	97(63.7)	171	3497	

N(%): Number (percentage), ATY: Average of temperature in year, AHY: Average of humidity in year.

including early in May and also in the first half of September; This indicates the two generation period per year is, for the insect (Figure 2).

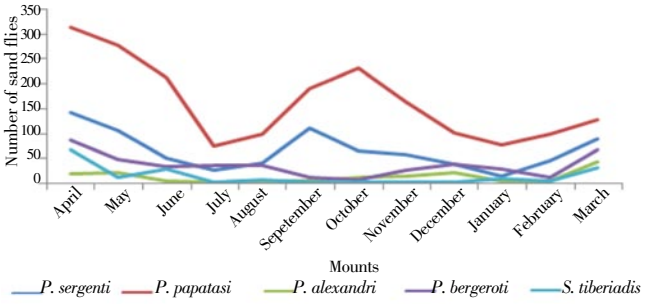

Figure 2. Monthly abundance of phlebotomine sandflies during April-October, 2009 in Asalouyeh region, Bushehr Province, Iran.

4. Discussion

Faunestic study of sand flies and the vectors of leishmaniasis, seems to be a crucial introduction to many epidemiological and ecological studies. The study of the epidemiology of the leishmaniasis, regardless of considering different aspects of sand flies, is not valuable. The survey results can be applied in making hypothesis of the epidemiology of the disease and the vectors. In this study, 5 species of sand fly were detected, 4 of genus *Phlebotomus* and one of genus *Sergentomyia*. This is the first report of faunae and monthly activities of sand flies as the vectors of cutaneous leishmainasis of sand flies in Asaluyeh District. Moreover, the studies conducted by Mesghali (1341), Oshaghi (1368) and Soleimani (1376) in Bastak in Hormozgan Province, near Assaluyeh, reported these five species as well[12,13]. *P. papatasi* included 56% of the total sand flies in Asalouyeh, thus is considered to be the dominant species in the region. This species was collected in indoor and outdoor (rodent burrows) places. *P. papatasi*, collected in indoor places, represents the endophilic property of the kind. Regarding the unknown nature of the parasite in the region as well as the fact that *P. papatasi* is a known vector of cutaneous leishmainasis in Iran's rural areas[8,9] and the related leptomonosis infection, reported in Isfahan, Golestan, Khorasan, Khuzestan, Bushehr Provinces[10], this phelebotomus can be most likely the vector of cutaneous leishmainasis in Asalouyeh. The before studies show that 5.6% of *P. papatasi* infected with leishmania major in Iran[14], which normally prefers to live in plains area rather than in mountains region[15], has been collected from all parts of Iran including Musian District (119 m above level of sea) from both the indoor and outdoor places. Cross and *et al.* have reported that *P. papatasi* is the most abundant in areas with mean minimum temperature of 16 °C and maximum temperature of 44 °C from May to October[16]. In a faunistic study in Jask, south of Iran, 8 species (3 *Phlebotomus* and 5 *Sergentomyia*) were reported by Azizi and Fekri[17]. Although it is suggested that the certain carriers of the disease to be determined in further studies. Moreover, the role of sand flies in the development of sandfly fever in south-southwest[18] as well as the unknown property of the disease in most parts of Iran, including Asalouyeh, recommend further parasitical studies to be done in this field.

Conflict of interest statement

We declare that we have no conflict of interest.

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Comments

Background

Sand flies are the sole vectors of some diseases; leishmaniases are the most important of them. Cutaneous leishmainasis and visceral leishmainasis forms are endemic in some parts of Iran; cutaneous leishmainasis is rapidly spread to almost all provinces of the country.

Research frontiers

Assalouyeh is financially an important region in Iran because of SPEEZ project which is one of the most important fields of gas in the world. Thousands of temporary workers are going to this town; some of them have active ulcers of cutaneous leishmainasis which could be reservoir of parasites for others. Otherwise, no control program will be successful without accurate information on the fauna and biology of vectors.

Related reports

There are numerous articles on the fauna and biology of sand flies and leishmaniasis vectors in many parts of Iran. In almost all of them *P. papatasi* was the dominant species and primary and proven vector of ZCL.

Innovations and breakthroughs

Apparently this was the only research on the sand flies in Assalouyeh town.

Applications

The results of this research could be used for designing an effective control program of leishmaniasis vectors.

Peer review

This is an ordinary article which gives useful information just on the fauna and some basic biological aspects of leishmaniasis vector (sand flies) in an important Iranian petrochemical gas field, southern Iran.

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