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 tow 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.


INTRODUCTION: Sand fly, fauna, Leishmaniasis, CL, VL, Alborz province.
humans from its reservoir hosts, mainly dogs by the bite of sand fly of genus *Phlebotomus* and VL in Iran is endemic in six provinces including East Azerbaijan, Ardebil, Fars, Bushehr, North Khorasan and Kerman.

**MATERIALS AND METHODS**

a) **Study area**

Alborz province is located in north of Iran and has an area of 5174 km² (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 mountainous areas and six locations inside urban areas in Alborz province were selected.

![Figure 1. The map of study area showing Alborz Province, Iran.](image)

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

<table>
<thead>
<tr>
<th>Specie</th>
<th>Sex ratio</th>
<th>Male</th>
<th>Female</th>
<th>indoors</th>
<th>Outdoors</th>
<th>Land area</th>
<th>Mountain area</th>
<th>Total</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ph. sergenti</em></td>
<td>2.6</td>
<td>1015</td>
<td>380</td>
<td>373</td>
<td>1022</td>
<td>810</td>
<td>585</td>
<td>1395</td>
<td>45.90</td>
</tr>
<tr>
<td><em>Ph. tobbi</em></td>
<td>6.19</td>
<td>714</td>
<td>126</td>
<td>455</td>
<td>385</td>
<td>215</td>
<td>625</td>
<td>840</td>
<td>27.60</td>
</tr>
<tr>
<td><em>Ph. mongolensis</em></td>
<td>0</td>
<td>191</td>
<td>0</td>
<td>53</td>
<td>133</td>
<td>135</td>
<td>56</td>
<td>191</td>
<td>6.28</td>
</tr>
<tr>
<td><em>Ph. perfilewii</em></td>
<td>13.5</td>
<td>137</td>
<td>13</td>
<td>115</td>
<td>35</td>
<td>35</td>
<td>115</td>
<td>150</td>
<td>4.93</td>
</tr>
<tr>
<td><em>Ph. papatasi</em></td>
<td>5.17</td>
<td>88</td>
<td>22</td>
<td>46</td>
<td>64</td>
<td>72</td>
<td>38</td>
<td>110</td>
<td>3.62</td>
</tr>
<tr>
<td><em>Ph. keshishiani</em></td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>66</td>
<td>34</td>
<td>23</td>
<td>77</td>
<td>100</td>
<td>3.30</td>
</tr>
<tr>
<td><em>Ph. caucasicus</em></td>
<td>0</td>
<td>82</td>
<td>28</td>
<td>54</td>
<td>52</td>
<td>30</td>
<td>82</td>
<td>2.70</td>
<td></td>
</tr>
<tr>
<td><em>Ph. major</em></td>
<td>7.5</td>
<td>49</td>
<td>7</td>
<td>44</td>
<td>12</td>
<td>18</td>
<td>38</td>
<td>56</td>
<td>1.85</td>
</tr>
<tr>
<td><em>Ph. caucasicus G.</em></td>
<td>0</td>
<td>0</td>
<td>42</td>
<td>37</td>
<td>5</td>
<td>9</td>
<td>33</td>
<td>42</td>
<td>1.38</td>
</tr>
<tr>
<td><em>Ph. alexandri</em></td>
<td>8</td>
<td>28</td>
<td>4</td>
<td>28</td>
<td>4</td>
<td>11</td>
<td>21</td>
<td>32</td>
<td>1.05</td>
</tr>
<tr>
<td><em>Ph. kandelaki</em></td>
<td>1.33</td>
<td>11</td>
<td>8</td>
<td>13</td>
<td>6</td>
<td>5</td>
<td>14</td>
<td>19</td>
<td>0.63</td>
</tr>
<tr>
<td><em>S. dentata</em></td>
<td>4.5</td>
<td>11</td>
<td>4</td>
<td>2</td>
<td>13</td>
<td>0</td>
<td>15</td>
<td>15</td>
<td>0.50</td>
</tr>
<tr>
<td><em>S. paulowskyi</em></td>
<td>0</td>
<td>8</td>
<td>------</td>
<td>6</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4.01</td>
<td>80.07</td>
<td>19.93</td>
<td>41.5</td>
<td>58.5</td>
<td>45.56</td>
<td>54.44</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
DISCUSSION
This study is the report of the results of entomological 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 *P. papatasi*, *P. sergenti*, *P. caucasicus*, *P. mongolensis*, *P. andrejevi*, *P. ansarii*, *P. salehi*, and VL proven or suspected vector species present in Iran are *P. alexandri*, *P. major*, *P. keshishiani*, *P. kandelakii*, and *P. perfiliewi*. The most CL and VL vectors identified in the study area. Further studies should focus on the existence of important vector species of sand flies in the different parts in Alborz province. 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. *Phlebotomus sergenti* was reported as *L. tropica* host by PCR in Shiraz and Kerman Cities [30] and. *Phlebotomus sergenti* has a wide distribution in the most province 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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