ZOONOTIC AND PARASITIC DISEASES

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ZOO NOTIC AND PARASITIC DISEASES

Proceedings of the Third International and Pan-Arab Seminar
held in Amman, Jordan, 17-20 October 1989

Edited by
Oumeish Youssef Oumeish and Panduka M. Wijeyaratne

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THE PRESENCE, DISTRIBUTION AND SEASONAL ABUNDANCE
OF POTENTIAL VECTORS OF CUTANEOUS AND
VISCERAL LEISHMANIASIS IN JORDAN
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Introduction

The increasing incidence of cutaneous leishmaniasis in Jordan over the last two decades and the occurrence of outbreaks in many parts of the country (Oumeish et. al., 1982; Saliba et. al., 1985) have drawn attention to the disease as one of the public health importance.

The information available on the presence and true incidence of visceral leishmaniasis in Jordan is scarce even though sporadic endogenous cases of the Mediterranean type occur every year. Recently, both cutaneous and visceral leishmaniasis were made notifiable diseases in Jordan (Qubain, 1989).

Psammomys obesus has been identified as the reservoir and Leishmania major as the causative agent of cutaneous leishmaniasis in the country (Saliba et. al., 1987). However, the sandfly vector(s) has yet to be determined. Some twenty-one species of sandflies are reported from Jordan to date (Kamhawi et. al., unpublished). Although eight of eleven Phlebotomus species collected have been incriminated or suspected of being vectors of leishmaniasis, elsewhere only four, Phlebotomus papatasi, P. sergenti, P. major and P. perfiliewi are thought to be potential vectors of cutaneous and visceral leishmaniasis in Jordan because of their abundance and endophily.

Objectives

This paper provides information on the seasonal fluctuations of Phlebotomus papatasi, P. sergenti and P. major in Swaima, El-Hemmah, the Amman area and the Ajlun Mountains. The significance of the relative abundance of P. perfiliewi in an indoor collection on the outskirts of Ibrid and the epidemiological significance of the presence and behaviour of these sandfly species in Jordan is discussed.

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Methodology

From July to December 1986 field trips were made throughout Jordan to thoroughly sample the sandfly population. This survey was purely qualitative; no attempt was made to standardize the number of trips, sites and traps used each month. The type of traps used included a CDC light-trap, aspirators, chemical light-sticks and sticky papers.

Quantitative sampling began in 1987 and 1988 when a set number of sticky traps, each made of an A4 sheet of paper (21 cm x 30 cm) was used. The traps were distributed in representative rural and domestic habitats in each area and sampled once a month. Each trip consisted of 2 consecutive days of sampling where a set of 70 traps, oiled with castor oil, was installed and replaced after each morning.

Selection of Sites and Results

In Palestine cutaneous leishmaniasis was found to be hyperendemic in the lower Jordan Valley and around the northern parts of the Dead Sea; *P. papatasi* and *P. obesus* were incriminated as the vector and principal reservoir species respectively (Naggan et. al., 1970; Schlein et. al., 1982). In Jordan, more than half of the cutaneous leishmaniasis cases reported during 1973-1978 came from the Jordan Valley region (Ouemeish et. al., 1982) and a village from the valley, Swaima, from the warm desert zone, was chosen as the first collection site.

The small village is situated 1 km north east of the Dead Sea and about 16 km south east of Jericho (Fig 1). During the preliminary investigations in 1986, *P. papatasi* was found to be the only abundant *Phlebotomus* species in Swaima which seemed ideal for the study of the seasonal fluctuation of this species. This was monitored from January to December 1987 (Fig 2b). The results of the 1986 collections (Fig 2a) should not be directly compared to those of 1987 but were included to show the abundance of *P. papatasi* in the domestic as well as rural habitats. In 1986 the maximum number of *P. papatasi* was collected in August when the species was more abundant in the domestic habitats (258 specimens) than in the rural ones (20 specimens) (Fig 2a).

In contrast, during the standardized quantitative seasonality study in 1987, the peak number of sandflies occurred in October when 143 sandflies, the majority from the rural habitats, were collected (Fig 2b). From April to August 1987 more flies were collected from the domestic habitats than later on in the year, the maximum number being collected in May (61 specimens). These trends are probably caused by changes in the weather. Although the temperature is the same in May and October, at around 27°C (Fig
The relative humidity is much lower in May. The dry weather in May and the relatively hot weather which occurs from June to September (Fig 6a) may cause most of the sandflies to rest indoors where the temperature is lower and the relative humidity higher than it is in the rural habitats.

The second site studied, El-Hemmah, is situated on the northern border of Jordan in the warm steppe zone (Fig 1) at low altitude (ca 75 cm below sea level). P. papatasi and P. major were the most abundant Phlebotomus species collected from the area. To our knowledge the presence of P. major in large numbers at this altitude has never been reported previously, P. major being usually considered a highland species. This observation and the opportunity to compare the season of P. papatasi in Swaima, which belongs to the warm desert zone, with that at El-Hamman made the latter an interesting site for the study of the seasonal fluctuation of P. papatasi and P. major in 1987 and 1988 (Fig 3). P. major seems to exhibit a bimodal behaviour in this area with an initial peak in May, better defined in 1988 than 1987, and a late one in November (Fig 3a-b). The number of specimens collected from the domestic habitats was larger in May and lower in November compared to the rural habitats. In May the temperature was higher and the relative humidity lower than in November (Fig 6b).

The behaviour of P. papatasi in El-Hemmah seems to be highly endophilic in nature (Fig 3c-d). The peak of the P. papatasi season is late in the year, around October and November. This is similar in timing to the peak in Swaima. However, the El-Hemmah population is predominantly domestic which may indicate the unsuitability of the rural habitats of El-Hemmah for the species.

The third site, in the Amman area, is situated in the cool steppe zone (Fig 1) and was affected by a recent outbreak of cutaneous leishmaniasis (Saliba et. al., 1985). A thorough insecticide spraying campaign of the area was carried out approximately three months before the initial sampling began in 1986. This resulted in poor collections throughout that year. The occurrence of the outbreak, the relative abundance of P. sergenti as well as P. papatasi and the opportunity to follow the rate of recovery, if any, of the sandfly population in the area made the Amman area a suitable study site.

Fig 4 a-c shows the seasonal fluctuation of P. papatasi and P. sergenti during 1987 and 1988. For both species in both years the peak of the season seems to be around August and September and both seem to be predominantly endophilic in their behaviour. As in El-Hemmah, the collection of both species in May 1988 was larger than in 1987.
There is a marked increase in sandfly numbers in 1987 and 1988 from the 1987 collections which produced only 9 P. papatasi and 16 P. sergenti in total from July to December. This indicates that the population is recovering rapidly from the spraying campaign which should therefore be maintained at the same intensity if control of the sandfly population is to be achieved.

The peak of the P. papatasi season seems to be earlier in the Amman area than it is in the Swaima and El-Hemmah, both of which belong to warm zones in the climatic regions of Koppen (Fig 1).

A site in the Ajlun Mountains was chosen to represent the cool Mediterranean zone (Fig 1). All the Phlebotomus species here, including P. papatasi and the most abundant species, P. major, came mostly from domestic habitats, i.e., they were highly endophilic (Figs 5a-c). The peak of the season for both species seems to be around August and September. This is similar to the peak of the season in the Amman area, also located in the cool zones but earlier than in Swaima and El-Hemmah in the warm zones. Again P. major seemed to exhibit a bimodal pattern of behaviour in 1988 (Fig 5b) with an initial peak in May preceding the peak in August. The 1988 collections again seem higher than those in 1987 although the monthly variation in temperatures were similar in both years (Fig 6c). However, the relative humidity was higher in 1988, particularly in August, perhaps permitting an increase in the sandfly population size and/or sandfly movement so that more were caught.

A pilot project aimed at assessing the effect of urbanization on the sandfly population of an area was carried out in June and July of 1988 in Irbid. Trapping indicated the relative abundance of P. perlifliewi in the area. Moreover, in August, an overnight indoor collection from a villa situated on the outskirts of Irbid indicated that Phlebotomus perlifliewi was present in relatively large numbers, mostly females (Table 1). The inhabitants of the villa complained of sandfly bites which were initially presumed to be due to P. papatasi. P. perlifliewi is clearly abundant and endophilic in Irbid.

Commentary on the Results

Ecological

The seasonal fluctuation of P. papatasi was monitored and compared at four ecologically distinct sites. Swaima, El-Hemmah, the Amman area and Ajlun Mountains. In Swaima and El-Hemmah, the sandfly season was found to be longer, with the peak late in the season around October and November. In the cooler Amman and Ajlun areas in the season is short, ending in October and peaking earlier in August or September. The optimum climatic conditions for P.
Table 1. The relative Abundance and Endophilic Behaviour of Phlebotomus perfiliewi in Irbid.

<table>
<thead>
<tr>
<th>Collections</th>
<th>PE</th>
<th>JA</th>
<th>O</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>June</td>
<td>12</td>
<td>6</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td>1324</td>
<td>1440</td>
</tr>
<tr>
<td>July</td>
<td>46</td>
<td>2</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td>151</td>
<td>422</td>
</tr>
<tr>
<td>August</td>
<td>6</td>
<td>34</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Indoors</td>
<td></td>
<td></td>
<td>32</td>
<td>171</td>
</tr>
</tbody>
</table>

(1)

KEY:

PE = Phlebotomus perfiliewi
JA = P. jacusieli
O = Other Phlebotomus species
SA = Sergentomya antennata
M = Males
F = Females
() = Bloodfed females

cluded in Jordan seem to be a temperature in the low to mid-twenties (°C) and a relative humidity in the high fifties or low sixties (%RH).

The P. papatasi populations of El-Hemmah and Ajlun were virtually restricted to the domestic habitats. In contrast, in Swaima and the Amman area which are dry desert sites which many active rodent burrows and scattered plants of the Chenopodiaceae, many more P. papatasi were caught in the rural habitats. El-Hemmah is a wet, lush, agricultural area with date and banana plantations and Ajlun Mountains are covered with evergreen Quercus forests. In Jordan, P. papatasi seems unable to establish itself in wet habitats with lush vegetation but flourishes in dry desert biotopes.

The relative abundance of P. sergenti in the Amman area and the absence form Swaima probably indicate the intolerance of this species to high temperatures since the relative humidity and rural nature of both regions are similar (Swaima is relatively hotter than the Amman area (Fig 6a & c)).
P. major is usually reported from high altitude mountainous and rocky areas (Buttiker & Lewis, 1983; Lane et al., 1988). However, it was found to be relatively abundant in El-Hemmah (ca 75 m below sea level) as well as in its typical habitat in the Ajlun Mountains (ca 760 m above sea level). Altitude, therefore, does not seem to play a major role in restricting the spatial distribution of this species.

The bimodal behaviour pattern of P. major in both El-Hemmah and the Ajlun Mountains may be an indication of a wide tolerance of climatic variation. The season was shorter in the Ajlun Mountains than in El-Hemmah. It ended in October with a peak in August or September in the former while lasting until December with a peak in November in the latter.

**Epidemiological**

The distribution of P. papatasi in Jordan seems to correspond to that of cutaneous leishmaniasis. The species was found to be abundant in Swaima and the Amman area, both regions in which the disease has been reported by Oumeish et al. (1982) and Saliba et al. (1985) who considered P. papatasi to be the primary vector of cutaneous leishmaniasis in Jordan.

The fact that P. papatasi is a proven vector of cutaneous leishmaniasis in surrounding countries such as occupied Palestine (Schlein et al., 1982) and Saudi Arabia (Killick-Kendrick et al., 1985), that it is abundant in the endemic areas of Jordan and that it has been shown to be endophilic in its behaviour seems to support this hypothesis. However, it remains essential to find *Leishmania*-infected specimens in the field and to assess the rate of infection in each biotope.

P. sergenti was found to be abundant in the Amman area from where an outbreak of cutaneous leishmaniasis occurred in 1982-1983 (Saliba et al., 1985). Although P. sergenti is usually collected in small numbers (Buttiker & Lewis 1983; Dedet et al., 1984) it may and must be considered as a possible vector of cutaneous leishmaniasis in Jordan. Lane et al. (1988) commented on the possibility of this species transmitting *Leishmania major* as well as being the proven vector of *L. tropica* (Le-Blancq & Peters, 1986; Al-Zahrani et al., 1988).

P. major is considered the principal vector of visceral leishmaniasis in the Mediterranean basin (Peters & Killick-Kendrick, 1987), it is the proven vector of canine visceral leishmaniasis in occupied Palestine and the suspected one in Saudi Arabia and Syria (WHO, 1984).
P. perfiliewi was recently proven to be the vector of cutaneous leishmaniasis, caused by L. infantum, in Italy (Maroli et. al., 1987) and is the suspected vector in Algeria (Belazzoug, 1987). It is also a suspected vector of visceral leishmaniasis in Tunisia (Ben-Rachid & Ben-Ismail, 1987).

The dramatic increase in the incidence of visceral leishmaniasis in many Middle Eastern countries including Saudi Arabia (Peters et. al., 1985; Al-Zahrani et. al., 1988), occupied Palestine (Jaffer et. al., 1988) and Egypt (Lane, 1986) indicates the need for intensive investigation of possible foci of the disease in Jordan.

The abundance of P. major and P. perfiliewi, both possible vector species, in areas where they exhibit an endophilic behaviour and where dogs which are potential reservoirs, are common and resting sites are available indicate that some of these areas are at risk of becoming new foci of visceral or cutaneous leishmaniasis if the appropriate causative agents were to be introduced to them.

The knowledge of the seasonal fluctuation and behaviour of those sandfly species which are of potential importance as vectors, either in current foci or risk areas, will be a great asset in the attempt to control the leishmaniasis by control of their vectors.

References


Figure 1: The map of Jordan divided into 6 climatic zones according to the model of Koppen (anon., 1984). It also indicates the location of the 5 sites sampled in this study.

Key to the climatic zones of Koppen:
1 = Cool temperate rainy climate
2 = Warm temperate rainy climate
3 = Cool steppe climate
4 = Warm steppe climate
5 = Cool desert climate
6 = Warm desert climate
Figure 2: Shows the seasonal fluctuation of *Phlebotomus papatasi* in Swaima for

a - 1986 collections:

![Graph showing seasonal fluctuation of Phlebotomus papatasi in 1986 collections.](image)

b - 1987 collections:

![Graph showing seasonal fluctuation of Phlebotomus papatasi in 1987 collections.](image)

KEY:
SF = Sandflies
ST = Sticky traps
= Wild habitats
= Domestic habitats
Figure 3: Shows the seasonal fluctuation of *Phlebotomus major* and *P. papatasi* in El-Hemmah in 1987/1988:

**P. major**

a - 1987

b - 1988

**P. papatasi**

c - 1987
d - 1988

**KEY:**

SF = Sandflies
ST = Sticky traps
□ = Wild habitats
■ = Domestic habitats
Figure 4: Shows the seasonal fluctuation of *Phlebotomus papatasi* and *P. sergenti* in Amman Area in 1987/1988:

**P. papatasi**

a - 1987

b - 1988

**P. sergenti**

c - 1987

d - 1988

**KEY:**
SF = sandflies
ST = Sticky traps
□ = Wild habitats
■ = Domestic habitats
Figure 5: Shows the seasonal fluctuation of *Phlebotomus major* and *P. papatasi* in the Ajlun Mountains in 1987/1988:

**P. major**

a - 1987

b - 1988

**P. papatasi**

c - 1987

d - 1988

**KEY:**

SF = Sandflies

ST = Sticky traps

= Wild habitats

= Domestic habitats
Figure 6: Shows the temperature (T °C) and the relative humidity (RH %) in 1987 & 1988 for:

a - Swaima:

b - El-Hemmah:

c - Amman Area:

d - The Ajlun Mountains:

T = Mean Monthly Temperature
RH = Mean Monthly Relative Humidity