1. Introduction

Phlebotomine sand flies (Diptera: Psychodidae) are the vectors for leishmaniasis as well as for arboviruses and bartonellosis and responsible of sandfly fever, summer meningitis, vesicular stomatitis, Chandipura virus encephalitis and Carrion’s disease[1].
In Morocco, leishmaniases are endemic diseases posing a major threat to public health. In 2011, Moroccan Ministry of Health reported 4319 cases of human cutaneous leishmaniases (CL) and 107 cases of visceral leishmaniases (VLL). CL caused by *Leishmania major* (*L. major*) (Kinetoplastida: Trypanosomatidae) is the most dominant form in the country with more than 24,450 cases reported in the last decade.[2]

*Phlebotomus papatasi* (*P. papatasi*) and *Phlebotomus sergentii* (*P. sergentii*) are known to be the common vectors spreading *L. major* and *Leishmania tropica* (*L. tropica*), respectively, in Morocco.

In the Mediterranean countries, *Leishmania infantum* (*L. infantum*) is the etiologic agent of VL.[3] While the subgenus "*Larroussius*" species: *Phlebotomus perniciosus* (*P. perniciosus*), *Phlebotomus ariasi* (*P. ariasi*) and *Phlebotomus longicuspis* (*P. longicuspis*) are considered as *L. infantum* vectors.[4]

Moreover, Asmae et al. (2014) have demonstrated the coexistence of *L. tropica* and *L. infantum* as causative agents of CL in the Sefrou province, northeast of the country.[5] Knowledge of the distribution of vectors is important in predicting the spatial variations in the risk of disease. Previous studies in Morocco[6-10] showed that the distribution of sandflies was due to the bioclimate in great part. Current findings in Morocco showed that altitude (through the gradient on temperature, pressure and precipitation) and aspect (through climate and vegetation) have an influence upon the spatial distribution and density of the sand fly fauna.[11,12].

In Morocco, other ecological factors are studied in their relationship with sand fly abundance and distribution such urbanization, proximity of humans and domestic animals, organic matter in the soil, shelter and vegetation type.[13,14]. In southern Morocco, little is known about species composition of sand fly fauna. Epidemiological situation of leishmaniases, especially in extreme south, needs to be updated. Actually, zoonotic cutaneous leishmaniases (ZCL) has spread endemically in the southern extreme south, needs to be updated. Actually, zoonotic cutaneous leishmaniases (ZCL) has spread endemically in the southern extreme south, needs to be updated. Actually, zoonotic cutaneous leishmaniases (ZCL) has spread endemically in the southern extreme south, needs to be updated. Actually, zoonotic cutaneous leishmaniases (ZCL) has spread endemically in the southern extreme south, needs to be updated. Actually, zoonotic cutaneous leishmaniases (ZCL) has spread endemically in the southern extreme south, needs to be updated.

In the present work, we discuss the possible effect of many ecological factors on the diversity and distribution of Moroccan sandflies through three transects: Ouarzazate-M’Hamid, Foum Zguid-M arrakesh and Erfoud-Nador (Table 1 and Figure 1). We give a particular attention to ZCL foci (Ouarzazate, Zagora, Tata and Errachidia) with the aim to update their entomological data.

### 2. Materials and methods

#### 2.1. Transects

Three transects were studied. On June 2010, the first transect was 267 km long and linked the cities of Ouarzazate and M’Hamid. This transect went through eight collection sites, where altitude varies from 552 to 1100 m, on the southern slopes of the High Atlas Mountains. The second transect was 537 km long from Foum Zguid to Marrakesh city and was studied on June 2011. This transect went through eight collection sites where altitude varies between 282 and 1720 m. The third and last transect was 1006 km...
long and connected Erfoud city to the city of Nador. This transect went through seven collection sites with altitude ranges from 61 to 1470 m and was studied on June 2012 (Figure 1).

2.2. Sandfly collection and identification

Sandflies were collected using sticky paper traps (each an A4 sheet of paper coated with castor oil) for one night. Specimens were preserved in 70% ethanol, cleared in 20% (w/v) KOH and Marc–André solution, and then mounted on microscope slides, in Hoyer’s medium.

Most of the sandflies were then identified to species by the armature and spermathecae (females), with the help of the keys and morphological examination of the genitalia (males) or the pharyngeal armature and spermathecae (females), with the help of the keys and descriptions published by Moroccan Ministry of Health[3,17].

For P. perniciosus complex, the females were identified by examining the dilatation of distal parts of spermathecal ducts and males by examining the shape of the copulatory valves and counting the number of coxite hairs[18,19].

2.3. Data analysis

Various ecological parameters were calculated to characterize the sand fly populations in the different sites and habitats:

Relative frequency =\frac{\text{Number of specimens of one species}}{\text{Total of specimens}} \times 100\%

Biodiversity index=(\text{S}-1)/\log N

Where N is the number of individuals, S refers to the number of species in the sample.

Sorensen index (Sorensen’s similarity coefficient) which can have values from 0 (no similarity) to 1.0 (complete similarity)= \frac{2a}{2a+b+c}

Where a: number of species in both sample A and sample B, b: number of species in sample A but not in sample B and c: number of species in sample B but not in sample A.

3. Results

Overall, 7140 sandflies were collected along the three transects. In the combined collections, nine Phlebotomus species: P. papatasi (27.6%), P. longicuspis (19%), P. sergenti (18.2%), P. perniciosus (6.2%), Phlebotomus bergeroti (P. bergeroti) (2.9%), Phlebotomus alexandri (P. alexandri) (1.4%), Phlebotomus chadlii (P. chadlii) (0.8%), Phlebotomus chabaudi (P. chabaudi) (0.5%) and Phlebotomus ariasi (P. ariasi) (0.5%) and five Sergentomyia species: Sergentomyia minuta (S. minuta) (10.4%), Sergentomyia fallax (S. fallax) (8.1%), Sergentomyia dreyfussi (S. dreyfussi) (2.1%), Sergentomyia christophersi (S. christophersi) (1.7%) and Sergentomyia africana (S. africana) (0.5%) were detected. The detail of sampling in each transect is shown respectively in Tables 2-4.

Among the 2 056 sandflies collected on the Ouarzazat-M’Hamid road, P. longicuspis was the most common species (25.5%), followed by P. papatasi (23.8%), S. fallax (12.6%), P. sergenti (16.6%), S. minuta (11%), P. bergeroti (5.4%), S. dreyfussi (1.8%), S. christophersi (1.7%) and P. ariasi, P. perniciosus, P. alexandri, P. chabaudi and P. chadlii with less than 1% each. The sex ratio was in favor of males for all species in all stations with the exception of S. minuta (M:F=13/14) in Tisserghate station and P. chadlii (0/1) in Ouarzazat city (Table 2).

On the Foum Zguid-M’arrakesh road, P. papatasi was the most prevalent species (25.2%) of a total of 2 370 sandflies collected, followed by P. longicuspis (17.5%), S. minuta (16.2%), P. perniciosus (11.7%), P. sergenti (11.7%), S. fallax (7.1%), S. dreyfussi (3.1%), S. christophersi (2.2%), P. bergeroti (1.9%) and P. alexandri (1.1%). We collected S. africana, P. chabaudi, P. ariasi and P. chadlii with less than 1% each as well. The sex ratio was in favor of females for P. ariasi in Ait aiaza, S. dreyfussi and S. christophersi in Tata city, while, it was in favor of males for all caught species in all other stations (Table 3).

Sandflies (2714) were collected on the Erfoud-Nador road.

### Table 2

| Species | P. papatasi | P. bergeroti | P. sergenti | P. alexandri | P. chabaudi | P. ariasi | P. perniciosus | P. longicuspis | P. chadlii | S. fallax | S. minuta | S. dreyfussi | S. christophersi | Total |
|---------|-------------|-------------|-------------|--------------|-------------|-----------|--------------|--------------|-----------|----------|----------|------------|---------------|-------|
| Site (code) | M | F | M | F | M | M | F | M | M | M | M | M | F | M | M | F |
| Ouarzazate (S1) | 36 | 15 | 0 | 0 | 24 | 11 | 3 | 1 | 2 | 1 | 11 | 2 | 0 | 0 | 43 | 24 | 0 | 1 | 12 | 3 | 12 | 2 | 1 | 3 | 0 | 0 | 1007 |
| Tisserghate (S2) | 106 | 13 | 0 | 0 | 144 | 25 | 0 | 0 | 0 | 0 | 2 | 1 | 5 | 1 | 224 | 20 | 0 | 0 | 18 | 15 | 13 | 14 | 0 | 0 | 0 | 1540 |
| Tninezouline (S3) | 52 | 11 | 0 | 0 | 20 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 123 | 6 | 0 | 0 | 19 | 7 | 12 | 10 | 0 | 0 | 0 | 127 |
| Beni zoli (S4) | 30 | 12 | 14 | 5 | 13 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 2 | 0 | 0 | 23 | 8 | 19 | 3 | 0 | 0 | 3 | 1 | 154 |
| Zagora (S5) | 23 | 7 | 13 | 3 | 20 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 |
| Tamegroute (S6) | 28 | 10 | 30 | 30 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 146 |
| Zaouia Sidi M’oktar (S7) | 33 | 18 | 11 | 1 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 15 | 7 | 16 | 7 | 7 | 0 | 5 | 3 | 132 |
| Ait nagem (S8) | 22 | 4 | 8 | 0 | 10 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 8 | 0 | 0 | 18 | 11 | 23 | 11 | 2 | 0 | 0 | 2 | 0 | 142 |
| Tagouitine (S9) | 19 | 8 | 10 | 2 | 16 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 4 | 0 | 0 | 23 | 2 | 18 | 9 | 10 | 4 | 1 | 0 | 0 | 145 |
| M’hamid (S10) | 30 | 12 | 1 | 0 | 15 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 33 | 18 | 12 | 2 | 7 | 1 | 3 | 0 | 143 |
| Total | M/F | 379/110 | 90/21 | 272/69 | 4/1 | 2/1 | 13/2 | 7/1 | 458/66 | 0/1 | 182/77 | 157/69 | 29/9 | 31/5 | 1624/432 |
| AII | M | 489 | 111 | 341 | 5 | 3 | 15 | 8 | 524 | 1 | 259 | 226 | 38 | 36 | 2 | 0 | 1056 |
Table 3
Number of males (M) and females (F) sandflies collected along the Foum Zguid-Marrakech transect.

| Site (code) | Total M/F | M | F | M | F | M | F | M | F | M | F | M | F |
|------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|
| Erfoud (S21) | 376/222 | 190 | 102 | 180 | 102 | 90 | 60 | 87 | 57 | 73 | 50 | 22 | 43 |
| Errachdia (S22) | 908/547 | 454 | 454 | 334 | 334 | 80 | 80 | 54 | 54 | 64 | 64 | 16 | 16 |
| Errachdia (S23) | 908/547 | 454 | 454 | 334 | 334 | 80 | 80 | 54 | 54 | 64 | 64 | 16 | 16 |

Table 4
Number of males (M) and females (F) sandflies collected along the Erfoud-Nador transect.

| Site (code) | Total M/F | M | F | M | F | M | F | M | F | M | F | M | F |
|------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|
| Erfoud (S21) | 22/13 | 5 | 17 | 12 | 5 | 7 | 10 | 6 | 10 | 4 | 2 | 2 | 1 |
| Errachdia (S22) | 56/34 | 16 | 10 | 40 | 24 | 8 | 4 | 20 | 12 | 6 | 4 | 2 | 0 |
| Medjel (S23) | 23/12 | 8 | 15 | 15 | 8 | 5 | 10 | 5 | 5 | 2 | 0 | 1 | 1 |
| Ouzergane (S24) | 88/53 | 21 | 17 | 67 | 56 | 11 | 10 | 56 | 51 | 4 | 3 | 0 | 0 |
| Tahanout (S25) | 23/14 | 8 | 15 | 15 | 8 | 5 | 10 | 5 | 5 | 2 | 0 | 1 | 1 |
| Marrakech (S26) | 32/18 | 11 | 17 | 11 | 17 | 6 | 10 | 6 | 10 | 3 | 2 | 2 | 1 |
| Total | 45/33 | 7 | 22 | 18 | 12 | 10 | 6 | 10 | 6 | 10 | 3 | 2 | 2 | 1 |

P. papatasi was the most prevalent species (34%), followed by P. sergenti (25.5%), P. longicuspis (15.5%), P. perniciosus (6.3%), S. fallax (5.3%), S. minuta (4.4%), P. alexandri (2.5%), P. chadlii (1.7%), P. bergeroti (1.2%) and S. dreyfusi (1.5%). S. africana, S. christophersi, P. ariasi and P. arisi with less than 1% each. Except for S. dreyfusi (in Errachadia, Medjel, Azzou and Chefchaouen) for each sandfly species, the males collected outnumbered the females in all stations (Table 4).

In the first and second transects, P. perniciosus males were collected only as atypical morphology (PNA), but in Erfoud-Nador road, both forms P. perniciosus typical (PN) and P. perniciosus atypical were collected in the same stations (Tables 2-4).

For ZCL foci, a total of 207 specimens were collected in Ouarzazat, 120 in Zagora, 323 in Tata and 214 in Errachidia city. P. longicuspis was the most abundant species in Ouarzazat with 32% while P. papatasi was the most prevalent once in Zagora, Tata and Errachidia with 25%, 46% and 42% respectively. Each of the 29 study sites was highly similar to the other sites with Sorensen similarity indexes varying from 0.74 to 1 (complete similarity).

Table 5 summarizes the numbers of sand fly species and individuals caught in each category of biotope and the corresponding sand fly biodiversity indices. If it is not null, the sand fly fauna biodiversity of peridomestic biotope of Issafn (S13) showed the greatest value while that in the Barbacanes of Al Houceima (S28) showed the least one.

Table 5
Sandflies caught in different biotopes along the 29 sites studied with the corresponding biodiversity index.

| Code | Biotope | S Individuals | Biodiversity index | Dominant species |
|------|---------|---------------|--------------------|------------------|
| S1   | Run     | 4             | 27                 | 0.91             | P. longicuspis   |
| S2   | Peridomestic | 10            | 170                | 1.75             | P. longicuspis   |
| S3   | Intradomestic | 7             | 307                | 1.05             | P. longicuspis   |
| S4   | Vegetation | 6             | 30                 | 1.47             | P. perniciosus   |
| S5   | Stable   | 6             | 80                 | 1.14             | P. papatasi     |
| S6   | Intradomestic | 7             | 66                 | 1.43             | P. papatasi     |
| S7   | Peridomestic | 6             | 68                 | 1.73             | P. papatasi     |
| S8   | Peridomestic | 5             | 12                 | 1.08             | P. papatasi     |
| S9   | Ruin     | 4             | 10                 | 1.03             | P. papatasi     |
| S10  | Intradomestic | 7             | 43                 | 1.33             | P. papatasi     |
| S11  | Peridomestic | 7             | 83                 | 1.36             | P. papatasi     |
| S12  | Intradomestic | 5             | 39                 | 1.09             | S. fallax       |
| S13  | Stable   | 4             | 29                 | 0.89             | P. papatasi     |
| S14  | Peridomestic | 8             | 81                 | 1.59             | P. longicuspis   |
| S15  | Rock crevices | 5             | 32                 | 1.15             | S. minuta       |

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We noted also that most of the Sergentomyia species collected were from sites far from human residences like wall, rock crevices, vegetation and peridomestic habitats.

Some qualitative and quantitative differences between biotopes were noted. In terms of number and specific richness of sand fly fauna, we collected 11 species in peridomestic biotope of S13, S23 and S24 whereas only three species in intradomestic biotope and barbacanes of S14 and S28 respectively.

We noted also that most of the Sergentomyia species collected were from sites far from human residences like wall, rock crevices, vegetation and peridomestic habitats.

### Table 5, continued

| Code | Biotope     | S Individuals | Biodiversity Index | Dominant species |
|------|-------------|---------------|--------------------|------------------|
| S9   | Peridomestic| 7             | 1.40               | S. fallax        |
| S10  | Peridomestic| 8             | 1.41               | P. papatasi      |
| S11  | Peridomestic| 8             | 1.51               | P. sergenti      |
| S12  | Peridomestic| 8             | 1.29               | P. sergenti      |
| S13  | Peridomestic| 7             | 1.39               | P. papatasi      |
| S14  | Peridomestic| 6             | 1.57               | S. minuta        |
| S15  | Intradomestic| 11            | 1.92               | P. sergenti      |
| S16  | Intradomestic| 6             | 1.36               | S. fallax        |
| S17  | Peridomestic| 7             | 1.52               | P. longicuspis   |
| S18  | Peridomestic| 7             | 1.56               | P. longicuspis   |
| S19  | Intradomestic| 6             | 1.41               | P. papatasi      |
| S20  | Barbacanes  | 5             | 1.00               | P. longicuspis   |
| S21  | Intradomestic| 6             | 0.71               | P. perniciosus   |
| S22  | Intradomestic| 6             | 0.88               | S. fallax        |
| S23  | Intradomestic| 5             | 0.88               | P. papatasi      |
| S24  | Intradomestic| 5             | 0.88               | P. papatasi      |
| S25  | Intradomestic| 6             | 0.88               | P. papatasi      |
| S26  | Intradomestic| 6             | 0.88               | P. papatasi      |
| S27  | Intradomestic| 6             | 0.88               | P. papatasi      |
| S28  | Intradomestic| 6             | 0.88               | P. papatasi      |
| S29  | Intradomestic| 6             | 0.88               | P. papatasi      |

### 4. Discussion

In Morocco, twenty three species of phlebotomine sandflies have been reported; 14 species of Phlebotomus genus and 9 species of Sergentomyia genus[2] of which five species have been known to transmit the disease: P. ariasi, P. perniciosus and P. longicuspis are vectors of L. infantum and are spread mainly in northern regions[19], P. papatasi is vector of humid form of cutaneous leishmaniases caused by L. major seen in the south and southeast of the Atlantic M ountains, while P. sergenti is the vector for the dry skin form of cutaneous leishmaniases caused by L. tropica, reported in the center of the country[20-22].

In this study, 14 sandfly species were identified, representing 60% of the Moroccan sand fly species. Two genera are identified; Phlebotomus (77.2%) and Sergentomyia (22.8%) and all vectors are well represented.

The five vectors - P. papatasi, P. ariasi, P. perniciosus, P. longicuspis and P. sergenti - made up 71% of the sandflies collected, while in 86% of study sites (25/29), three of them - P. papatasi, P. sergenti and P. longicuspis - coexist.

We suggest that leishmaniases in Morocco is more related to the parasite ecology rather than the vector distribution, even if the vector occurrence is very important. Role of different vectors are often determined by species-level co-evolution of susceptibility to Leishmania species, with selection being initiated and maintained by ecological contacts[23].

Vector-borne and zoonotic disease transmission risk is the result of interactions between different species in space and time[24]. But, many entomological investigations in Morocco show no correlation between these vectors distribution and disease distribution even if the hosts and reservoir playing a role in the transmission of Leishmania are present in both endemic and non-endemic area[11,24,25].

The distribution of P. papatasi extends from southern Europe and eastern regions to the Indian subcontinent and highly depends on environment factors particularly relative humidity and temperature.

It thus largely exceeds those of L. major[11]. In Egypt for example, ZCL is primarily present in northern Sinai while the vector distribution is more extensive[26]. Until now, despite the wide distribution of both P. papatasi and Meriones shawi in Morocco, ZCL and L. major are restricted to the pre-Saharan areas.

In Iran, Yavar et al. (2013) found natural infection of P. papatasi by L. infantum, with the absence of human VL cases. This vector has the ability to transmit two species of Leishmania parasite: L. major and L. infantum[27].

P. sergenti has also an extensive geographical distribution, wider than that of the anthropootic cutaneous leishmaniases[28,29]. In Portugal, P. sergenti showed a very short period of activity in...
It is suggested that the presence of *P. sergenti* in *L. tropica* free areas is related to the existence of some cryptic vector species with consequences in their capacity to readily transmit *Leishmania* and/or mechanisms of transmission for *Leishmania* parasites. In Spain, two *P. sergenti* lineages were identified, a typically Spanish mitochondrial lineage and another one that is common in Morocco.

*Phlebotomus ariasi*, *P. perniciosus* and *P. longicuspis* are considered as *L. infantum* vectors. The vectorial role of *P. ariasi* has been described in northern Morocco when, previous studies showed the presence in Morocco of three phylogenetic species of *P. perniciosus* complex: *P. perniciosus* including PN and PNA-like morphs; *P. longicuspis* sensu stricto and a sibling species of *P. longicuspis* (LCx). The atypical morph of *P. perniciosus* was identified also in Tunisia and in Algeria. The vectorial capacity and competence of these *P. perniciosus* morphs as well as of *P. longicuspis* and its potential cryptic species should be confirmed.

*L. infantum* is widespread mainly in northern Morocco as causative agent of cutaneous and visceral leishmaniasis with sporadic cases of human visceral leishmaniasis in the south. Boussaa et al. (2008) noted the same distribution of *P. perniciosus* forms. In North of Morocco, typical morphs of *P. perniciosus* are the most abundant forms, while in the southern regions, are mainly an atypical form.

Our results confirm this distribution, atypical morphology of *P. perniciosus* males was collected in the first and second transects, but in Erfoud-Nador road, both forms were collected in the same stations. Monitoring the insects in natural ecosystem is one of the simplest ways to observe and provide early warning of changes to biodiversity and habitat structure.

In our study, species presence and diversity appeared to be affected by several factors. According to altitude, which acting through its relationship with climate, we noted relatively low biodiversity at the highest (1720 m) and low-altitude (61 m) sites investigated. Jahanifard et al. (2014) did find similar results in Iran, showing *P. papatasi* to be found between 8 and 1756 m. In contrast, some species prefer high altitude such as *P. ariasi* collected only between 920 and 1720 m. Other species change their sites according to bioclimatic factors. For example, *P. chabaudi* and *P. chadlii* were collected at high altitude in arid climate and low altitude with humid climate.

On the other hand, a high diversity level in Saharan areas has been found when the species are structured on bioclimate basis. Our results are similar to the other authors that found a high diversity of sandflies in sites ranged from 900 to 1100 m. Nador and Al Hoceima are two coastal cities and show a low specific richness level.

In conclusion, the wide distribution of vectors in different forms of leishmaniases in Morocco could increase the risk to spread of different species of *Leishmania* from many foci to nonendemic sites. This suggests the need for a continuously surveillance to control the situation in these foci and to prevent risk in nonendemic areas.

**Conflict of interest statement**

We declare that we have no conflict of interest.

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**Comments**

**Background**

Human CL is a serious public-health problem in Morocco with active foci from 1970s. Several faunistic studies related to the distribution of phlebotomine sandflies in these foci have provided important data by describing the species involved in CL. The study on populations of sandflies by entomological surveys and the climatic factors that could affect their distribution need to be studied in new foci of CL.

**Research frontiers**

This type of works contributes to the need for appropriate control programs for Leishmaniases in endemic countries.

**Related reports**

There are many reports related to this research in other regions of Morocco. In overall, in the three transects studied, nine *Phlebotomus* species were found. *P. papatasi* was the most prevalent species responsible of *L. major* spreading and human CL.

**Innovations & breakthroughs**

This is the first contribution in which entomological studies are related with ecological factors from Northern to Southern of Morocco where twenty-nine sampling stations were studied along three transects with a high diversity of *Phlebotomus* species found.
Applications

Entomological surveys in areas where leishmaniasis foci occur are imperative for the control of the disease. This work contributes to a better understanding of the distribution of the different species of sandflies present along three transects in Morocco in relation to ecological factors to undertake better control programs in this country.

Peer review

In this work authors conducted an entomological survey along three transects of Morocco where foci of cutaneous leishmaniasis occur. The data obtained gives practical information and suggests the need for a continuous entomological surveillance in this country.

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