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SANDFLIES ON THE ISLAND OF CORFU, GREECE

PAPADOPOULOS B.* & TSELENTIS Y.*

Summary :

The island of Corfu is an endemic area of human leishmaniasis, mainly visceral and secondly cutaneous. In August 1996, a survey of phlebotomine sandflies was conducted throughout the whole island. Using castor-oil paper traps, a total of 2,615 sandflies were caught. The following species were identified: 450 (17.21 %) *Phlebotomus neglectus*, 213 (8.15 %) *P. tobbi*, 129 (4.93 %) *P. perfiliewi*, 12 (0.46 %) *P. sergenti*, 11 (0.42 %) *P. simici*, 4 (0.15 %) *P. papatasi*, 999 (38.20 %) *Sergentomyia minuta* and 797 (30.48%) *S. dentata*. Among the potential vectors of *Leishmania* spp , *P. neglectus*, *P. tobbi* and *P. perfiliewi*, were the most widespread species on the island. However, a decrease of the population density of sandflies compared to previous entomological studies was observed.

KEY WORDS : Sandflies, Greece.

Résumé : LES PHLÉBOTOMES DE L'ÎLE DE CORFU, GRÈCE

L'île de Corfu est une région endémique de leishmaniose humaine viscérale et secondairement de leishmaniose cutanée. En août 1996, une étude sur les phlébotomes a été entreprise dans toute l'île. Au total, 2 615 phlébotomes ont été capturés par la méthode des pièges adhésifs. Les espèces suivantes ont été identifiées: 450 (17,21 %) Phlebotomus neglectus, *213 (8,15 %)* P. tobbi, *129 (4,93 %)* P. perfiliewi, *12 (0,46 %)* P. sergenti, *11 (0,42 %)* P. simici, *4 (0,15 %)* P. papatasi, *999 (38,20 %)* Sergentomyia minuta *et 797 (30,48 %)* S. dentata. *Parmi les vecteurs potentiels de* Leishmania *spp.*, P. neglectus, P. tobbi *et* P. perfiliewi *sont les espèces les plus répandues. Toutefois, une baisse de la densité des populations de phlébotomes par rapport aux études entomologiques précédentes a été observée.*

MOTS CLÉS : *Phlébotomes, Grèce.*

The prefecture[1] of Corfu, consisting of the island of Corfu and some surrounding small islands, is one of the four prefectures of the Ionian Islands lying to the west of mainland Greece. It is an endemic area of human leishmaniasis, mainly visceral and secondly cutaneous. According to the data of the Greek Ministry of Health, during the period 1951-1995, 56 cases of visceral leishmaniasis (VL) and 22 cases (12 of them in 1951) of cutaneous leishmaniasis (CL) were recorded in this prefecture. The incidence of leishmaniasis in dogs, considered to be the domestic reservoir host of VL in the Mediterranean region, is much higher. During the last nine years (1988-1996) for which detailed statistics are available from the Office of Animal Health of the Greek Ministry of Agriculture, 297 canine cases were reported by the local Veterinarian Services.

Leishmania infantum, the causative agent of zoonotic VL and sporadic cases of CL, has been isolated in Corfu from a human, a dog and a sandfly. In 1981, Tzamouranis *et al.* (1984) succeeded in isolating and typing *L. infantum* from a human and a dog that had overt leishmaniasis, while in 1987, Léger *et al.* (1988) isolated a parasite from *Phlebotomus neglectus*, which was found by isoenzyme characterization to be indistinguishable from *L. infantum* zymodeme MON1 (= LON49).

In an early study conducted before the second World War, Stephanides (1940) observed that *P. papatasi* was the most abundant sandfly species in the human habitations of Corfu. Later, during the period 1979-1981, in a large scale entomological survey conducted on the island by the team of Prof. N. Léger, sandflies of eight different species were captured (Madulo-Leblond, 1983; Pesson *et al.*, 1984).

In this paper we present the results of a massive sampling of sandflies throughout the island of Corfu conducted in August 1996.

STUDY AREA

The island of Corfu (592 km^2, 104,781 inhabitants) is the northernmost large island of the Ionian sea. In terms of administration, this island with other surrounding small islands form the

[1] Prefecture : administrative division of the country.

* Laboratory of Clinical Bacteriology, Parasitology, Zoonoses and Geographical Medicine, Faculty of Medicine, University of Crete, P.O. Box 1393, Iraklion Crete, Greece.
Correspondence: Dr. B. Papadopoulos.
Tel.: 081 394076-394743-394801 - Fax: 081 394408.
E-mail: byron@edu.uch.gr

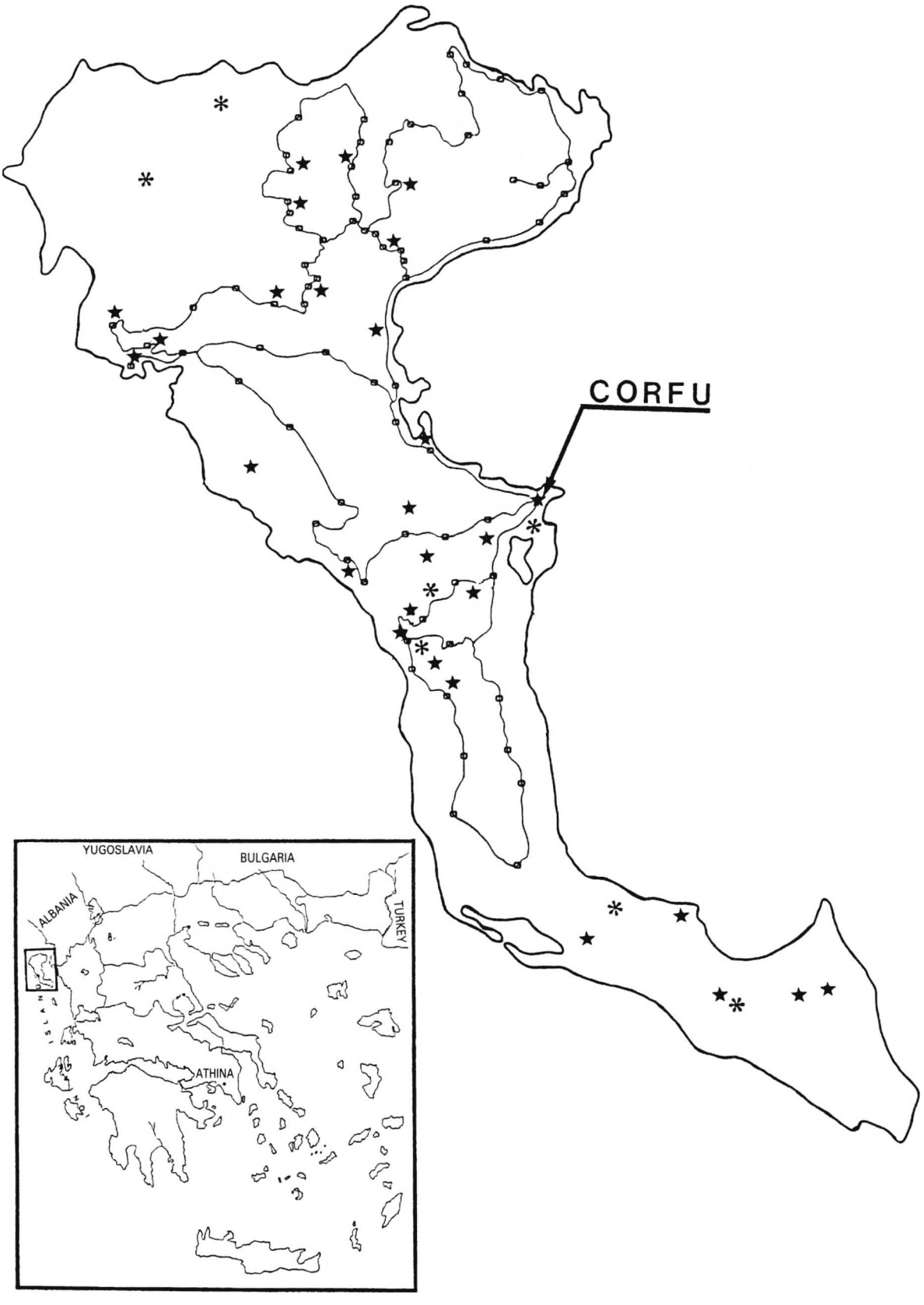

Fig. 1. – The island of Corfu with the stations in which the entomological survey was carried out (O) and sites from where human VL (★) and CL (✳) cases were reported during the period 1951-1995.

prefecture of Corfu (642 km², 107,592 inhabitants). Its capital is the city of Corfu (31,359 inhabitants) situated on the west coast of the island. The island of Corfu is situated in the north-west part of Greece, opposite the region of Hepirus in the Greek mainland and Albania, between 39° 22' and 39° 49' north latitude and 19° 38' and 20° 08' east longitude (Fig. 1). The island is about 62 km long and 28 km wide in its northern part, reduced to 3.5 km in its narrowest southern part. Most of the island is of low altitude (< 100 m). Mount Pantocrator, 906 m in altitude, in the north is its highest point. There is also a mountain ridge, with a maximum altitude of 576 m, in the central-southern region. The rest of the island is flat to hilly. The whole island belongs to the attenuated mesomediterranean type of the mediterranean bioclimate (Mavrommatis, 1980). It is located on the January isotherm of 10 °C and the July isotherm of 25.5 °C. The relative humidity is relatively high during the entire year (65-75 %) and the mean annual precipitation is 1,150 mm.

The entomological survey was conducted along transects at 72 stations, mainly in the north and the central part of the island (Fig. 1). The stations were located at points whose altitude ranged from 20 to 680 m.

MATERIALS AND METHODS

The entomological survey was carried out between August 16 and August 23, 1996, in 72 stations on transects throughout the island (Fig. 1). Sandflies were caught using castor-oil treated paper sheets (A4 format photocopy papers). A total of 1,170 castor-oil treated paper sheets were set and 1,125 of them were recovered (losses 3.85 %).

The sticky traps (10 to 30 traps/station) were placed into any potential sandfly breeding or resting site (holes or cracks in dry walls or rocks; spaces in stone walls; pipes of buildings or gardens). The papers were left in place for four days. The specimens were then picked up with a fine paint-brush, washed in 90 % ethanol, cleared and mounted in Marc-André solution for identification, which was made according to the descriptions of Léger *et al.* (1986).

In order to estimate the relative densities of the sandfly species in the different stations, the number of sandflies collected per 100 paper traps (sf/100 pt) per station was calculated. Stations with < 25 sf/100 pt are considered of low density for the species in question, stations with 25-100 sf/100 pt of middle density and stations with > 100 sf/100 pt of high density.

RESULTS

A total of 2,615 sandflies were collected during August 1996. Table I shows the species identified, their total number, their relative density (number of sandflies per 100 paper traps), their percent of total, the number of males and females and the proportion of females for each species, as well as the number of localities in which they were found and their percent of total.

All but nine stations were positive for sandflies. About 1/3 of the captures were *Phlebotomus* spp. and the rest 2/3 *Sergentomyia* spp. (Table I). Almost all samples of *Phlebotomus* spp. belong to the subgenus *Larroussius*, *P. neglectus* being the most abundant and widespread. For *Sergentomyia* spp. almost equal numbers of males and females were captured, while for *Phlebotomus* spp. the *sex ratio* was strongly in favor of males.

Sandfly species	No of sf	No of sf/100 pt	% of total sf	♂♂	♀♀	♀♀/♂♂ + ♀♀	No of localities	% of localities
Phlebotomus (Phlebotomus) papatasi	4	0.36	*0.15 %*	3	1	0.25	2	*2.78 %*
Phlebotomus (Paraphlebotomus) sergenti	12	1.07	*0.46 %*	9	3	0.25	5	*6.94 %*
Phlebotomus (Larroussius) neglectus	450	40.00	*17.21 %*	351	99	0.22	48	*66.67 %*
Phlebotomus (Larroussius) perfiliewi	129	11.47	*4.93 %*	101	28	0.22	30	*41.67 %*
Phlebotomus (Larroussius) tobbi	213	18.93	*8.15 %*	175	38	0.18	39	*54.17 %*
Phlebotomus (Alderius) simici	11	0.98	*0.42 %*	9	2	0.18	4	*5.56 %*
Total of Phlebotomus spp.	***819***	***72.80***	***31.32 %***	***648***	***171***	***0.21***	***54***	***75.00 %***
Sergentomyia (Sergentomyia) dentata	797	70.84	*30.48 %*	369	428	0.54	32	*44.44 %*
Sergentomyia (Sergentomyia) minuta	999	88.80	*38.20 %*	484	515	0.52	51	*70.83 %*
Total of Sergentomyia spp.	***1,796***	***159.64***	***68.68 %***	***853***	***943***	***0.53***	***54***	***75.00 %***
Total of sandflies	**2,615**	**232.44**	***100.00 %***	**1,501**	**1,114**	**0.43**	**63**	***87.50 %***

No of sf, number of sandflies; No of sf/100 pt, number of sandflies per 100 paper traps; % of total sf, percentage of the total number of collected specimens; ♂♂, number of males; ♀♀, number of females; ♀♀/♂♂+♀♀, proportion of females; No of localities, number of localities in which they were found; % of localities, percentage of the total number of localities.

Table I. – Sandfly species on the island of Corfu.

Sandfly species	< 25 sf/100 pt		25-100 sf/100 pt		> 100 sf/100 pt	
	No of localities	% of localities	No of localities	% of localities	No of localities	% of localities
Phlebotomus (Phlebotomus) papatasi	2	2.78 %	0	0.00 %	0	0.00 %
Phlebotomus (Paraphlebotomus) sergenti	3	4.17 %	2	2.78 %	0	0.00 %
Phlebotomus (Larroussius) neglectus	21	29.17 %	19	26.39 %	8	11.11 %
Phlebotomus (Larroussius) perfiliewi	15	20.83 %	14	19.44 %	1	1.39 %
Phlebotomus (Larroussius) tobbi	21	29.17 %	15	20.83 %	3	4.17 %
Phlebotomus (Alderius) simici	3	4.17 %	1	1.39 %	0	0.00 %
Total of Phlebotomus spp.	***14***	***19.44 %***	***23***	***31.94 %***	***17***	***23.61 %***
Sergentomyia (Sergentomyia) dentata	10	13.89 %	10	13.89 %	12	16.67 %
Sergentomyia (Sergentomyia) minuta	9	12.50 %	27	37.50 %	15	20.83 %
Total of Sergentomyia spp.	***7***	***9.72 %***	***22***	***30.56 %***	***25***	***34.72 %***
Total of sandflies	**5**	***6.94 %***	**21**	***29.17 %***	**37**	***51.39 %***

No of localities, number of localities; % of localities, percentage of the total number of localities.

Table II. – Distribution of the localities the sandfly species were found according to their relative density (number of sf/100 pt).

Table II shows the distribution of localities where the different sandfly species were found according to their relative density. Most of the species were found in low (< 25 sf/100 pt) or medium (25-100 sf/100 pt) densities.

DISCUSSION

Our entomological results are generally in agreement with those obtained by Madulo-Leblond (1983) about 15-17 years earlier. However, the relative density of almost all sandfly species was lower in our survey. This is probably due to the drop in the number of most sandfly species during August (Madulo-Leblond, 1983; Papadopoulos & Tselentis, 1994) and the extensive use of insecticides, especially against the crop pests, during the last years.
All three *Phlebotomus* spp. belonging to the subgenus *Larroussius*, *P. neglectus*, *P. tobbi* and *P. perfiliewi*, are considered potential vectors of *L. infantum*. *P. neglectus*, the most common *Phlebotomus* sp. on the island, is still the only sandfly species from which a *L. infantum* has been isolated in the Ionian islands (Léger *et al.*, 1988; Garifallou *et al.*, 1989). *P. perfiliewi* has been found infected with viscerotropic *L. infantum* in Italy (Maroli *et al.*, 1988) and dermotropic *L. infantum* in Algeria (Izri & Belazzoug, 1993), while *P. tobbi* has been infected experimentally by feeding on infected hamsters (Adler &d Theodor, 1935).
The rarity of *P. papatasi*, vector of *L. major* and sandfly fever, in our captures is noteworthy. This species was considered by far the most abundant species in Corfu in human habitations (Stephanides, 1940). The scarcity observed may be due to the low number of domestic sites explored with the method of transects using castor-oil paper traps, as discussed in a previous article (Papadopoulos & Tselentis, 1994). This species is nowadays found to be abundant only in Eastern Crete, Karpathos and Athens (Pesson *et al.*, 1993; Papadopoulos & Tselentis, 1994; Chaniotis *et al.*, 1994).
P. sergenti, which was long suspected (Adler *et al.*, 1938) but only recently proved to be a vector of *L. tropica* (Al-Zahrani *et al.*, 1989; Guilvard *et al.*, 1991), was rare in Corfu, where only few cases of CL have been recorded. This species is relatively abundant in the warmer and drier southern Ionian Islands and especially in Zakynthos (Pesson *et al.*, 1984), the principal focus of CL in the region. It should be noted that *P. sergenti*, as well as *P. simici*, become very rare late in the season (Madulo-Leblond, 1983).
The sandflies of the genus *Sergentomyia*, captured in high numbers during our study, feed on reptiles and therefore have no epidemiological interest as vectors for human and canine leishmaniasis.

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Erratum

PAPADOPOULOS B. & TSELENTIS Y. Sandflies in the Greater Athens region. *Parasite*, 1994, *1 (2)*, 131-140.

Sandfly species	Nbr sf	%	♂♂	♀♀	♀♀/ ♂♂ + ♀♀	Nbr local.
Phlebotomus (Phlebotomus) papatasi	541	*18.40 %*	414	127	0.23	40
Phlebotomus (Paraphlebotomus) alexandri	30	*1.02 %*	28	2	0.07	9
Phlebotomus (Paraphlebotomus) sergenti	13	*0.44 %*	10	3	0.23	3
Phlebotomus (Larroussius) neglectus	1,002	*34.08 %*	915	87	0.09	55
Phlebotomus (Larroussius) tobbi	182	*6.19 %*	163	19	0.10	27
Phlebotomus (Alderius) simici	50	*1.70 %*	46	4	0.08	16
Sergentomyia (Sergentomyia) minuta	1,122	*38.16 %*	747	375	0.33	40
Total	**2,940**	***100.00 %***	**2,323**	**617**	**0.21**	**64**

Table I. – Nbr sf, number of sandflies; %, percentage of the total number of collected specimens; KK, number of males; ΛΛ, number of females; ΛΛ/KK + ΛΛ, proportion of females; Nbr local., number of localities they were found.