



Sandflies (Diptera: Phlebotominae) of the Canary Islands

RICHARD P. LANE

Department of Entomology, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, UK

and BRUCE ALEXANDER

Entomology and Nematology Department, University of Florida, 3103 McCarty Hall, Gainesville, FL 32611, USA

(Accepted 10 April 1987)

Of the four species of phlebotomine sandflies known from the Canary Islands one is endemic. The subgenus *Phlebotomus* (*Abonnencius*), created to accommodate this endemic species, is newly synonymized with *Ph.* (*Anaphebotomus*). The biology of Canary Island sandflies is summarized and a comparison of the fauna to that of continental Africa suggests a closer affiliation to the endemic Palearctic than to the Afrotropical Region.

KEYWORDS: Sandflies, Phlebotominae, *Phlebotomus*, Canary Islands

The sandfly fauna of the Canary Islands was unknown until recently, when Ubed Ontiveros *et al.* (1982) described a new endemic species, *Ph. fortunatarum*. Subsequently, Morillas *et al.* (1984) recorded *Sergentomyia minuta* (Rondani) and *S. falla* (Parrot) and described a new subgenus, *Phlebotomus* (*Abonnencius*), for the endemic *Ph. fortunatarum*.

This paper describes further collections made by one of us (B.A.) in September 1982, records an additional species of *Phlebotomus* (*Ph. sergenti* Parrot), discusses the status of *Ph.* (*Abonnencius*), and compares the limited fauna with that of continental Africa.

There are no published reports of autochthonous cases of leishmaniasis from the Canary Islands, despite the occurrence of the disease in North Africa (Morocco, Mauritania) and West Africa (Gambia, Sénégal) (see Zahar, 1980, for review). The only known vector species from the islands is *Ph. sergenti*, which has been incriminated as a vector of leishmaniasis in the eastern part of its range (Crete, Iraq, USSR).

Materials and methods

Sandflies were collected in castor oil supported on sticks, and torchlight traps, in which a torch was shown through a clear perspex sheet (15 × 23 cm) coated in castor oil. Traps were placed among rocks and old lava flows, in caves and crevices, and besides stone walls.

Collections were made in southern Tenerife, around El Me'dano, and near Arrecif in Lanzarote (see Table 1 for details). Both areas are arid with sparse vegetation. Fernandopulle (1976) describes the climate of the islands, Schmincke (1976) the geology, and Bramwell (1976) and Lems (1960) the flora.

Results and discussion

Table 1 lists the details of specimens collected at each site. Four species were found on Tenerife, increasing the known fauna for the island group by one—*Ph. sergenti*.

Only *S. fallax* was found on the island of Lanzarote which had not previously been prospected for sandflies.

The discussion will be in three parts: taxonomy of Canary Island sandflies, a comparison with previous studies and faunal associations.

Table 1. Results of trapping for sandflies on Tenerife and Lanzarote

Locality	Habitat	Nights trapped (no.)	Species caught
TENERIFE			
La Laguna	Farmland, slopes above town	3	
Bajamar	Crevices in rocky ravine 1 km from coast	2	<i>rum</i>
Puente del Hidalgo	Rocky ravine	4	<i>rum</i>
H Mediano	Crevices in lava flows 1 km from sea, very dry	4	<i>iti</i>
LANZAROTE			
Arrecife	Cracks in lava piles, very dry area	3	<i>x</i>
Teguise	Dry stone walls	2	

Taxonomy of Canary Island sandflies

Four species of sandflies are now known from the Canary Islands, two of *Phlebotomus* Rondani & Berté and two of *Sergentomyia* Franca & Parrot.

The subgenera *Anaphlebotomus* and *Abonnencius*. In the original description of *Ph. fortunatarum* the authors did not assign it to a subgenus, but noted that its long tubular spermathecae are very similar to those of the African species *Ph. rodhaini* Parrot, but the male differed in the number of spines on the style and in the shape of the paramere. *Phlebotomus rodhaini* is a typical member of the subgenus *Anaphlebotomus* which currently has five species, three from the Oriental Region and two from the Afrotropical Region. Males of *Anaphlebotomus* species have four spines on the style and heavily sclerotized genital pumps. By the inclusion of *Ph. rousettus* Davidson, Davidson (1981) expanded the range of paramere shape shown by *Anaphlebotomus* to include species with simple as well as bi-lobed and tri-lobed parameres. Female *Anaphlebotomus* are characterized by the unusually long tubular spermathecal ducts. The body of the spermathecae may be either smooth-walled (and thus indistinguishable from the ducts) or finely segmented (as in *rousettus*).

Morillas Marquez *et al.* (1984) erected a monotypic subgenus, *Abonnencius*, to accommodate *Ph. fortunatarum*. One of the main criteria for establishing this subgenus was that the male aedeagus is truncated-cone-shaped with a moon-shaped appendage. However, *rodhaini*, like other species of *Anaphlebotomus*, also has a truncated-cone-shaped aedeagus, but instead of a posteriorly projecting moon-shaped aedeagal appendage it has anteriorly projecting extensions at its base. Similarly, *Ph. rousettus* has small, pointed extensions present at the base of the aedeagus. The shape of these

extensions varies both within and between species, and is affected by orientation of the specimen and possibly some torsion during mounting. It is probable, therefore, that the modification of the aedeagus of *fortunatarum* is homologous to, and an elaborated form of, that seen in *rodhaini* and other species. Two further 'obstacles' against the inclusion of *fortunatarum* in the subgenus *Anaphlebotomus* are the presence of five spines on the style, instead of four, and the nature of the pharyngeal armature in the female. Neither of these characters seems to justify the erection of a new subgenus since the number of spines on the style may vary within a subgenus (e.g., *Lutzomyia (Psychodopygus)* (1–5 spines); *Lu. (Pressatia)* (2–3 spines); *Lu. (Dampfomyia)* (3–5 spines); *Lu. (Micropygomyia)* (4–5 spines),) and the pharyngeal armature may vary considerably within a subgenus (e.g., *Sergentomyia (Sergentomyia)*.) Furthermore, there is substantial variation in the female pharynx within the genus *Anaphlebotomus*, the long broad teeth of the oriental *Ph. hoepflii* Tang & Maa contrasting with the small transverse ridges of small, often barely discernible, teeth of *Ph. rodhaini*.

Therefore, we formally synonymize the subgenus *Abonnencius* with *Anaphlebotomus* and redefine the latter as follows:

Anaphlebotomus Theodor, 1948: 99

Type-species: *Phlebotomus stantoni* Newstead, 1914, by original designation.

Abonnencius Morillas Marquez, Castillo Remiro and Ubeda Ontiveros, 1984: 35. Type-species: *Phlebotomus fortunatarum* Ubeda Ontiveros, Morillas Marquez, Guevara Benitez, Lopez Roman and Cutillas Barrios, 1982, by monotypy. Syn. nov.

Male. Coxite lobe absent, four or five spines on style, genital filaments often long; paramere simple, bilobed or trilobed, aedeagus with one or two basal appendages.

Female. Spermathecal ducts very long, demarcation of body of spermatheca and ducts often vague; spermatheca either smooth-walled or segmented.

Ph. (Anaphlebotomus) fortunatarum Ubeda Ontiveros *et al.*

Phlebotomus fortunatarum Ubeda Ontiveros, Morillas Marquez, Guevara Benitez, Lopez Roman and Cutillas Barrios, 1982: 199. Syntypes 42 ♂, 4 ♀, Spain: Canary Islands. LECTOTYPE designated [as HOLOTYPE] by Ubeda Ontiveros and Morillas Marquez (1983) (Facultad de Farmacia, Granada, Spain).

Phlebotomus (Abonnencius) fortunatarum, Morillas Marquez *et al.* 1984.

This species is characterized in the male by the genitalia, particularly the shape of the aedeagus, broad but simple paramere and five spines on the style. The female may be distinguished from other species of the genus by the shape of the pharynx and the very long spermathecal ducts terminating in a smooth-walled spermatheca with a pointed apex.

Phlebotomus sergenti Parrot

Phlebotomus sergenti Parrot, 1917: 564. SYNTYPES 5, Algeria (Institut Pasteur, Algiers).

This species has not been recorded previously from the Canary Islands. Throughout its range from Morocco to India it has been found to be both endo- and exo-philic and is a common peri-domestic species.

Sergentomyia minuta (Rondani)

Hebomus minutus Rondani, 1843: 263. Type(s) Italy (depository unknown).

This species is easily differentiated in the female from other species of the

subgenus by the large number of closely packed cibarial teeth, often in a curved row. The male can be distinguished from *S. fallax* by the short, finger-shaped aedeagus and short, thick style.

The form *S. minuta parroti* has been recognized in North Africa as a distinct taxon by many authors, but Belazzoug *et al.* (1982) have shown that the distinguishing features are highly correlated with environmental variables, particularly humidity, and therefore it is not considered a separate subspecies.

Sergentomyia fallax (Parrot)

Phlebotomus minutus var *fallax* Parrot, 1921: 37. Syntypes, Algeria, Tunisia (Institut Pasteur, Algiers).

The pharynx of the female (a diagnostic character) is quite variable in this species but specimens from the Canary Islands are like the typical form, with a gradual variation in the size of teeth from the posterior to the anterior, and square posteriorly with a medial notch. The males have slender styles at least four times as long as wide.

On the principal basis of absolute size this species has been divided into three subspecies: *fallax cypriotica* Theodor, *f. afghanica* Artemiev and *f. fallax* (Parrot). However, Lane (1986) has shown that the validity of at least two of these subspecies (*fallax* and *cypriotica*) is dubious.

Comparison with other surveys.

In the first survey of the islands, Ubeda Ontiveros *et al.* (1982) sampled both Tenerife and Gran Canaria during July and August. In their second survey, reported in Morillas Marquez *et al.* (1984), Tenerife, Hierro and Gomera were sampled, during April and May (Tenerife) and November (Hierro). Details were not given for work on Gomera.

A summary of the distribution of sandflies on the Canary Islands is given in Table 2.

The pooled ratio of *fortunatarum*: *fallax*: *minuta* found by Morillas Marquez *et al.* (1984) was 274:5:9, which is similar to the ratio of 41 *fortunatarum* to one *Sergentomyia* sp. indet., as found by Ubeda Ontiveros *et al.* (1982). In contrast to the dominant proportion of *Phlebotomus* in these data, our results showed *Sergentomyia* were dominant with a pooled ratio of *fortunatarum*: *sergenti*: *fallax*: *minuta* of 3:3:123:9 (made during September). These data are significantly different and may be due to differences in habitat sampled, sampling method, or, perhaps, the season.

Table 2. DISTRIBUTION OF SANDFLIES ON THE CANARY ISLANDS.

	Gran Canaria	Tenerife	Lanzarote	Hierro	Gomera
U O	<i>Ph. fortunatarum</i>	None found	n.s.	n.s.	n.s.
M M	<i>Sergentomyia</i> sp.	<i>fortunatarum</i>	n.s.	<i>fortunatarum</i>	<i>fortunatarum</i>
	n.s.	<i>fallax</i>		<i>minuta</i>	<i>fallax</i>
		<i>minuta</i>			<i>minuta</i>
L&A	n.s.	<i>fortunatarum</i>	<i>fallax</i>	n.s.	n.s.
		<i>sergenti</i>			
		<i>fallax</i>			
		<i>minuta</i>			

U O, Ubeda Ontiveros *et al.* (1982); M M, Morillas Marquez *et al.* (1984); L&A, Lane & Alexander (1986). n.s., not sampled.

Faunal associations

In general, the fauna of the Canary Islands is typical of the Palaearctic eremic zone and represents the most westerly limit of this zone. However, it is significant that the ubiquitous *P. papatasi*, so typical of this type of habitat in North Africa and the Mediterranean, is absent. *Sergentomyia minuta* is widespread around the Mediterranean and *S. fallax* has a similar distribution with a greater penetration of the eastern Afrotropical region. As noted above, *Ph. fortunatarum* is an endemic species, a relatively rare occurrence in sandflies at least at the level of morphospecies. Its closest relative is the widely distributed *Ph. (Anaphlebotomus) rodhaini* which occurs in a broad band through central Africa from Kenya and Sudan in the east through Uganda, Ethiopia, Congo, Benin, Guinea to S n gal and Gambia in the west. There are no Palaearctic species of *Anaphlebotomus*. The presence of *Ph. fortunatarum* in the Canary Islands adds a potential Afrotropical element to the fauna and may represent an ancient extension of a precursor species of *rodhaini* and *fortunatarum*.

Dedet *et al.* (1980) found 30 *Ph. duboscqi* and 2 *Ph. rodhaini* with 2245 specimens of 11 species of *Sergentomyia* in a river valley in Senegal, a typical African proportion of individuals and species of *Phlebotomus* to *Sergentomyia*. In contrast, a more typically Palaearctic ratio of *Phlebotomus* to *Sergentomyia* species was found in Tunisia of 10:5 by Croset *et al.* (1978). The presence of only four species of sandflies on the Canary Islands, two *Phlebotomus* and two *Sergentomyia*, makes comparisons rather difficult, although there is perhaps more similarity of the Palaearctic Tunisia than to Afrotropical districts. According to the ecological classification of Croset *et al.* (1978), the Canary Island fauna is "Mediterranean Afrotropical with [Palaearctic] eremic tendencies". The Canary Islands constitute the most westerly part of the Palaearctic eremic zone which extends to Pakistan in the east.

Phlebotomus sergenti is a Palaearctic species distributed from India through the middle East, to Mediterranean Europe and North Africa. It has only been found in the Afrotropical region in the mountains of Ethiopia, probably as an extension from the Arabian Peninsula. The presence of *Ph. sergenti* and the absence of *papatasi* is rather enigmatic as these two species are commonly sympatric in northern Africa, and *papatasi* has the more extensive range of the two. Climatic factors are unlikely to explain the discrepancy because, although *sergenti* is able to withstand colder temperatures than *papatasi*, the winters in the Canary Islands are mild and therefore the situation remains a puzzle.

The two species of *Sergentomyia* and possibly *Ph. fortunatarum* feed on lizards and therefore the affinities of the lizard fauna may add further evidence concerning the affiliations of the sandflies. The lizard fauna is composed of three endemic species of Lacertidae, three endemic skinks and two geckoes. The endemic species have sister groups in Spain or North Africa and the geckoes are widespread North African species (N. Arnold, personal communication).

Phlebotomus fortunatarum has been found on Gran Canaria, Tenerife, Hierro and Gomera; Fuerteventura has not been sampled and Lanzarote was sampled but was negative for this species in the present study. This distribution correlates (albeit rather loosely) with the current hypothesis for the origin of the Canary Islands (Rothe and Schmincke, 1968) in which Fuerteventura and Lanzarote are proposed as continental in origin and the remaining islands are oceanic (volcanic) in origin. These authors reject earlier suggestions, based on tenuous biological data, that the Canary Islands were connected to one another and to the African continent by a land bridge in the Tertiary period. In a summary of the dipteran fauna of the Canary Islands, Bacz (1982)

calculates that, of the 800 species recorded, 300 are endemic and the majority of the remainder are Palaearctic in origin. The sandfly fauna, small as it is, crudely conforms to this situation.

The sandfly fauna may have originated from more than one 'invasion'. It is possible that *fortunatorum* represents the earliest invasion from Africa since this is the only endemic species, assuming that endemism indicates a longer period of separation. This would be analogous to the ancient African floral element discussed by Lems (1960). The remaining three sandfly species are either geologically more recent introductions, or these species have repeatedly colonized the islands and thereby maintained a more diverse gene-pool.

Acknowledgements

This work received financial support from the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases, and the Godman Trust. We wish to thank the Keeper of the Department of Entomology, British Museum (Natural History) for providing facilities and Dr R. W. Crosskey for useful discussions.

References

- BAEZ, M., 1982. Consideraciones sobre las características zoogeográficas de la fauna de Canarias. *Instituto de Estudios Canarios 50 Aniversario*. Tenerife: Instituto de Estudios Canarios.
- BLAZZOUQ, S., MAHZOUL, D., ADDADI, K. and DEDEI, J. P., 1982. *Sergentomyia minuta parroti* (Adler & Theodor, 1927) en Algeria (Diptera: Psychodidae). *Annales de Parasitologie Humain et Comparee* **57**, 621-630.
- BRAMWELL, D., 1976. The endemic flora of the Canary Islands. *Monographiae Biologicae* **30**, 207-240.
- CROISEL, H., RIOUX, J. A., MAISTRE, M. and BAYAR, N., 1978. Les Phlébotomes de Tunisie (Diptera, Phlebotomidae). *Annales de Parasitologie Humain et Comparee* **53**, 711-749.
- DAVIDSON, I. H., 1981. The subgenus *Anaphlebotomus* of *Phlebotomus* (Diptera: Psychodidae: Phlebotominae) in southern Africa. *Journal of the Entomological Society of Southern Africa* **44**, 259-264.
- DEDEI, J. P., WINSHALL, R., HAYES, R. D. and DESJEUX, P., 1980. Les Phlébotomes (Diptera: Psychodidae) de la vallée de fleuve Sénégal. *Annales de Parasitologie Humain et Comparee* **55**, 125-133.
- FERNANDEZPULLE, D., 1976. Climatic characteristics of the Canary Islands. *Monographiae Biologicae* **30**, 185-206.
- LANE, R. P., 1986. The sandflies of Egypt. *Bulletin of the British Museum (Natural History) (Entomology)* **52**, 1-35.
- LEMS, K., 1960. Floristic Botany of the Canary Islands. *Sarracenia* **5**, 1-94.
- MORILLAS MARQUEZ, F., CASTILLO REMIRO, A. and UBEDA ONTIVEROS, J. M., 1984. Nuevos datos sobre *Phlebotomus fortunatorum* Ubeda Ontiveros y cols., 1982 y presencia de *Sergentomyia fallax* (Parrot, 1921) (Diptera, Phlebotomidae) en el archipelago Canario. *Revista Iberica Parasitologica* **44**, 29-38.
- PARROT, L., 1917. Sur un nouveau phlébotome algérien. *Phlebotomus sergenti* sp. nov. *Bulletin de la Société de Pathologie Exotique* **10**, 564-567.
- PARROT, L., 1921. Sur une variété nouvelle de *P. minutus*. *Bulletin de la Société de l'Afrique du Nord* **12**, 37-40.
- RONDANI, C., 1834. Species italicæ generis Hebotomi, Rndn. ex insectis dipteris: fragmentum septimum ad inveniendam dipterologiam italicam. *Annales de la Société Entomologique de France* **1**, 263-267.
- ROTHE, P. and SCHMINCKE, H. U., 1968. Contrasting origins of the eastern and western islands of the Canarian Archipelago. *Nature* **218**, 1152-1154.
- SCHMINCKE, H. U., 1976. The geology of the Canary Islands. *Monographiae Biologicae*, **30**, 67-184.
- THEODOR, O., 1948. Classification of the Old World species of the subfamily Phlebotominae. *Bulletin of Entomological Research* **39**, 85-111.
- UBEDA ONTIVEROS, J. M. and MORILLAS MARQUEZ, F., 1983. Designación del holotipo de *Phlebotomus fortunatorum* Ubeda Ontiveros y cols. (Diptera, Phlebotomidae). *Revista Iberica Parasitologica* **43**, 307-308.
- UBEDA ONTIVEROS, J. M., MORILLAS MARQUEZ, F., GUEVARA BENTIEZ, D. D., LOPEZ ROMAN, R. and CUTILLAS BARRIOS, C., 1982. Flebotomos de las Islas Canarias (España). *Revista Iberica Parasitologica* vol. Extra, 197-206.
- ZAHAR, A. R., 1980. Studies on the Leishmaniasis Vectors/ Reservoirs and their Control in the Old World. Unpublished Document WHO/VBC/80/766. Geneva: World Health Organisation.