A DESCRIPTION OF THE FEMALE OF *PHLEBOTOMUS* (LARROUSSIUS) *FANTALENSIS* LEWIS, MINTER & ASHFORD, 1974 WITH SUPPLEMENTARY NOTES ON THE MALE AND *P. (L.) GIBIENSIS* LEWIS, MINTER & ASHFORD, 1974

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Summary :

Description is given for the previously unknown female of *Phlebotomus* (Larrousius) *fantalensis* from Ethiopia. Supplementary descriptive notes are also given on its male and the related *P. (L.) gibiensis* with illustrations of their spermathecae/ducts and aedeagi which show morphological and size variation between the two species.

KEY WORDS : *Phlebotomus fantalensis*, *Phlebotomus gibiensis*, Larrousius, description, leishmaniasis, Ethiopia.

Résumé : DESCRIPTION DE LA FEMELLE DE *PHLEBOTOMUS* (LARROUSSIUS) *FANTALENSIS* LEWIS, MINTER & ASHFORD, 1974. NOTES COMPLÉMENTAIRES SUR LE MÂLE ET *P. (L.) GIBIENSIS* LEWIS, MINTER & ASHFORD, 1974

La femelle, jusqu'ici inconnue de *Phlebotomus* (Larrousius) *fantalensis*, est décrite d'après des échantillons capturés dans la localité type de l'espèce en Ethiopie. Des notes supplémentaires sont également présentées sur le mâle de la dite espèce ainsi que sur les deux sexes de *P. (L.) gibiensis*. Les deux espèces diffèrent tant par la structure des conduits de la spermatheque que par la forme des valves péniennes.

MOTS CLÉS : *Phlebotomus fantalensis*, *Phlebotomus gibiensis*, Larrousius, description, leishmaniose, Éthiopie.

INTRODUCTION

Lewis *et al.* (1974) described *Phlebotomus* (Larrousius) *fantalensis* Lewis, Minter & Ashford from four males collected from Metahara in eastern Ethiopia (species B of Ashford, 1974), and *P. (L.) gibiensis* Lewis, Minter & Ashford from a single female and five males (of 12 males) collected from Ghibe Gorge in southwestern Ethiopia (species A of Ashford, 1974). Since then, the two species have not been reported either from their type localities or any other place. The present description of the female of *P. fantalensis* is based on collections made recently from the type locality.

Since the original descriptions of the two species were based on inadequate specimens and some minor differences and omissions were noted, supplementary descriptions are given for the male *P. fantalensis* and for both sexes of *P. gibiensis* from topotypes recently collected.

Ten specimens of each sex of each species will be deposited in The Natural History Museum, London, UK.

METHODS

Phlebotomus fantalensis was collected from its type locality in the volcanic blisters near Metahara, eastern Ethiopia. *P. gibiensis* was also collected from its type locality in the Ghibe Gorge, southwestern Ethiopia. The sandflies were collected in 1993 and 1994 mainly with CDC miniature light traps, but occasionally with oiled plastic sheets and aspirators. Specimens were prepared for study by methods described by Minter (1963). The sandflies were wetted in detergent, washed in a few changes of water and cleared in Nesbitt's solution for about 12 hours. They were then preserved in 70 % alcohol until they were mounted in Berlese's gum chloral for morphological studies and measurements or until they were dissected for the spermathecae and their ducts.

The morphological characters used were both absolute and relative (measurements and ratios), based on those of Lewis *et al.* (1974), Artemiev (1980), Gebre-Michael & Lane (1993) and Killick-Kendrick *et al.* (1993b). Fifteen specimens of each sex of each species were used for this purpose. A single male of *P. gibiensis* found sympatrically with *P. fantalensis* in Metahara was also

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measured for comparison with the original description and with topotypes. In females 35 characters were used and in males, 44. When measurements were completed, the most important and basic characters were chosen to describe the new female *P. fantaleusis* and to compare males and females of *P. fantaleusis* and *P. gibliensis*.

Dissections to reveal the spermathecae and their ducts and bases were performed according to Gebre-Michael & Lane (1993) and Killick-Kendrick *et al.* (1994); measurements were made from camera lucida drawings under the X25 or X40 objectives.

DESCRIPTION

PHLEBOTOMUS (LARROUSSIS) FANTALEUSIS LEWIS, MINTER & ASHFORD, 1974

FEMALE (15 measured)

Length: (clypeus to cerci inclusive): 3.14 ± 0.03 (2.76-3.62) mm. *Antenna*: formula 2/III-XV; III 0.36 ± 0.03 (0.33-0.43) mm, 1.18 ± 0.04 (1.13-1.27) times length of IV + V, III/Labrum 1.04 ± 0.05 (0.97-1.13), ascoids on IV 0.43 ± 0.03 (0.38-0.5) of segment. *Labrum*: 0.34 ± 0.03 (0.31-0.39) mm, 0.12 ± 0.01 (0.11-0.13) of wing. *Palpal formula*: 1,4, 2,3,5. *Cibarium*: unarmed. *Pharynx* (Fig. 1A & B): as in *P. gibliensis* (see Lewis *et al.*, 1974), armatures occupying 0.26 ± 0.03 (0.16-0.28) of its length. *Wing*: length 2.55 ± 0.58 (2.49-3.18) mm, width 0.74 ± 0.07 (0.67-0.86) mm, L/W 3.74 ± 0.14 (3.52-3.93), R2/R2+3 1.97 ± 0.18 (1.71-2.25), R1 apex/R2 0.27 ± 0.04 (0.20-0.34), delta + 0.17 ± 0.04 (0.12 ± 0.24 mm). Spermatheca (Fig. 1A & B) with 10-14 segments leading gently to a short striated section (0.006-0.008 mm wide) and then to a longer and slightly expanded thin-walled part of the duct (max. width, 0.012-0.014 mm) ending in a simple but slightly expanding tube-like base. The two bases open separately in the genital orifice; the diameter of each opening is 0.013-0.017 mm. There are no lateral structures or dilatations associated with the bases. The length, measured from the duct base to the distal end including the terminal process is 0.24 ± 0.02 (0.21-0.27) mm in 12 good dissections.

SUPPLEMENTARY DESCRIPTION OF *P. FANTALEUSIS* (MALE) AND *P. GIBIENSIS* (MALE AND FEMALE)

A summary of the morphological examination and measurements of topotypes of the present study compared with original description is given in the Table. With few exceptions, the characters of topotypes of male *P. fantaleusis* and of both sexes of *P. gibliensis* correlated very well with the original description as shown in the Table.

• Male of *P. fantaleusis*

Variation in the length of the body (original, 2.37-2.66 mm; topotypes, 2.86-3.74 mm) and an error in the ratio of the length of aedeagus to the wing (original, 0.62-0.74; topotypes, 0.06-0.07) were noted. Most other characteristics in the present series only resulted in a broadened range of measurements due to a larger number of specimens than in the original series (Table I).

Some of the omissions in the original description of the male *P. fantaleusis* include the pharynx, characters on the wing (delta) and structures associated with the genitalia (Table I). Most notable of these is the aedeagus (Fig. 2A & B), some features of which distinguish the male from that of *P. gibliensis*. The length of the aedeagus 0.15 ± 0.01 (0.13-0.17) mm is 9.47 ± 1.01 (8.24-11.33) times as long as its width which is 0.015 ± 0.002 (0.013-0.018) mm at about the middle. The aedeagus is slender and is slightly swollen (0.014-0.019 mm wide) in side view at about 0.04-0.06 mm from the rounded tip.

• *Phlebotomus gibliensis* Lewis, Minter & Ashford, 1974

Female

Although the original description of the female was based on a single specimen, most characters correspond well with the present measurements which are based on 15 specimens (Table I). However, the original R1 apex which is 0.8 length of R2 is probably an error compared with the present series which is 0.35 ± 0.03 (0.29-0.41). The armature occupying 0.25 ± 0.02 (0.22-0.27) of the pharynx which is 0.22 ± 0.12 (0.20-0.26) mm long also showed considerable variation. The commonest palpal formula is 1-4-2-3-5 (13 out of 15), but rarely also 1-4-(2-3)-5 and 1-4-3-2-5. Omissions in original include R1 apex (Delta) which is $+0.25 \pm 0.03$ (+0.18-0.29) mm long.

The spermathecae (Fig. 1C & D) generally resemble those of *P. fantaleusis*, but are clearly distinguishable. Overall, they are shaped like a pair of socks. They have 11 to 14 rings leading to a shorter and thinner striated part of the ducts (0.005-0.006 mm wide) which in turn lead to a considerably expanded, thin-walled and unstriated part of the ducts (max. width, 0.026-0.029 mm) opening separately through simple tube-like bases in the genital orifice. The ducts are much wider than in *P. fantaleusis*. As in *P. fantaleusis*, the bases lack any dilatation or lateral structures and are wider at their openings (diameter of each is 0.024-0.034 mm). The length of the spermatheca, measured from the duct base to the distal end of the terminal process is 0.34 ± 0.02 (0.30-0.37) mm in nine good dissections; it is much longer than in *P. fantaleusis*. No variations were noted between the present observations and the original figures by Lewis *et al.* (1974) except that some

Fig. 1. — The spermathecae and ducts of *P. fantalensis* (A & B) and *P. gibliensis* (C & D).

Fig. 2. — Aedeagi of *P. fantalensis* (A & B) and *P. gibiensis* (C & D); pharynx of *P. fantalensis* (E & F).

Characters	<i>P. fantalensis</i>		<i>P. gibliensis</i>				
	Male ^a		Female		Male		
	Original N = 4	Topotypes N = 15	Original N = 1	Topotypes N = 15	Original N = 5	Topotypes N = 15	Metahara 1995
Length	— ^b (2.37-2.66)	3.28 ± 0.26 (2.86-3.74)	3.35	3.30 ± 0.18 (2.95-3.52)	2.45	3.18 ± 0.16 (2.84-3.41)	2.46
Ascoid formula	2/III-VIII 1/IX-XV	2/III-VIII 1/IX-XV	2/III-XV	2/III-XV	2/III-VIII 1/IX-XV	2/III-VIII 1/IX-XV	2/III-VIII 1/IX-XV
AIII	— (0.32-0.40)	0.38 ± 0.03 (0.33-0.44)	0.42	0.39 ± 0.03 (0.33-0.43)	0.41	0.42 ± 0.03 (0.35-0.46)	0.36
AIII/IV + V	— (1.07-1.13)	1.11 ± 0.04 (1.02-1.15)	1.17	1.16 ± 0.03 (1.10-1.21)	1.1	1.13 ± 0.03 (1.09-1.15)	1.08
AIII/Labrum	— (1.31-1.51)	1.39 ± 0.10 (1.27-1.54)	1.17	1.03 ± 0.04 (0.98-1.08)	1.5	1.37 ± 0.06 (1.30-1.52)	7.33
Ascoid/AIV	— (0.29-0.35)	0.30 ± 0.03 (0.26-0.36)	0.33	0.41 ± 0.04 (0.35-0.44)	0.27	0.27 ± 0.02 (0.25-0.30)	0.29
Palpal formula	1-4-2-3-5(2) 1-2-4-3-5(2)	1-4-2-3-5	1-4-(2-3)-5	1-4-2-3-5(13) 1-4(2-3)-5(1) 1-4-3-2-5(1)	1-4-2-3-5(2) 1-2-4-3-5(3)	1-4-2-3-5	1-4-2-3-5
Pharynx (P)	—	0.19 ± 0.01 (0.17-0.20)	—	0.22 ± 0.12 (0.20-0.26)	—	0.19 ± 0.01 (0.18-0.21)	0.19
Pharyngeal teeth/P	—	—	0.15	0.25 ± 0.02 (0.22-0.27)	—	—	—
Labrum	— (0.21-0.27)	0.28 ± 0.02 (0.24-0.31)	0.36	0.38 ± 0.02 (0.32-0.41)	0.28	0.31 ± 0.02 (0.27-0.33)	0.27
Labrum/WL	— (0.10-0.12)	0.12 ± 0.01 (0.11-0.13)	0.14	0.13 ± 0.003 (0.13-0.14)	0.11	0.12 ± 0.01 (0.11-0.13)	0.12
Wing length (WL)	— (2.02-2.31)	2.33 ± 0.16 (2.17-2.57)	2.85	2.97 ± 0.17 (2.49-3.24)	2.45	2.59 ± 0.18 (2.11-2.91)	2.27
Wing width (WW)	— (0.55-0.63)	0.65 ± 0.05 (0.57-0.73)	0.79	0.87 ± 0.07 (0.68-0.95)	0.67	0.72 ± 0.04 (0.64-0.76)	0.61
WL/WW	— (3.50-3.63)	3.60 ± 0.15 (3.35-3.93)	3.6	3.42 ± 0.12 (3.26-3.68)	3.70	3.62 ± 0.12 (3.30-3.38)	3.72
R ₂ /R ₂₊₃	— (1.68-2.05)	1.88 ± 0.21 (1.57-2.26)	1.5	2.06 ± 0.22 (1.66-2.38)	2.0	2.09 ± 0.3 (1.73-2.90)	1.78
R ₁ apex/R ₂	— (0.15-0.25)	0.28 ± 0.05 (0.16-0.33)	0.8	0.35 ± 0.03 (0.29-0.41)	0.28	0.32 ± 0.05 (0.21-0.38)	0.21
Delta (R ₁ apex)	—	0.14 ± 0.02 (0.08-0.17)	—	0.25 ± 0.03 (0.18-0.29)	—	0.19 ± 0.04 (0.11-0.27)	0.10
Coxite length (CL)	— (0.28-0.32)	0.32 ± 0.02 (0.30-0.35)	—	—	0.32	0.35 ± 0.02 (0.32-0.39)	0.30
Coxite width (CW)	—	0.072 ± 0.003 0.065-0.078	—	—	—	0.077 ± 0.006 0.067-0.088	0.06
Style length (SL)	—	0.15 ± 0.05 (0.14-0.17)	—	—	—	0.17 ± 0.01 (0.16-0.18)	0.15
CL/SL	—	2.10 ± 0.10 (1.94-2.21)	—	—	1.9	2.12 ± 1.11 (1.89-2.31)	2.0
No. coxite hair	12-17	16-18	—	—	17	17-20	17
Position of coxite hair	—	0.17 ± 0.01 (0.15-0.19)	—	—	—	0.18 ± 0.01 (0.16-0.21)	0.16
Paramere	—	0.25 ± 0.02 (0.21-0.27)	—	—	—	0.25 ± 0.01 (0.24-0.27)	0.24
Spermathecae, segments	—	—	11	11-14	—	—	—
Spermathecae, length ^c	—	—	0.30 ^d	0.34 ± 0.02 (0.30-0.37)	—	—	—
Genital filament (GF)	—	0.52 ± 0.04 (0.47-0.59)	—	—	—	0.58 ± 0.08 (0.37-0.75)	0.54
Genital Pump (GP)	— (0.11-0.14)	0.14 ± 0.01 (0.13-0.16)	—	—	—	0.17 ± 0.01 (0.15-0.18)	0.14
GF/GP	— (3.6-4.2)	3.71 ± 0.23 (3.38-4.07)	—	—	3.4	3.56 ± 0.5 (2.17-4.41)	3.86
Aedeagus length (AL)	— (0.13-0.16)	0.15 ± 0.01 (0.13-0.17)	—	—	0.17	0.17 ± 0.09 (0.16-0.18)	0.15
Aedeagus width (AW)	—	0.015 ± 0.002 (0.013-0.018)	—	—	—	0.023 ± 0.001 (0.02-0.024)	0.02
AL/AW	—	9.47 ± 1.01 (8.24-11.33)	—	—	—	7.48 ± 0.65 (6.96-8.57)	7.5
AL/WL	— (0.62-0.74)	0.06 ± 0.06 (0.06-0.07)	—	—	0.07	0.07 ± 0.01 (0.04-0.08)	0.07

^a Data for female in text; ^b Not measured or recorded; ^c Measured from the terminal process up to the opening of the duct in the genital atrium; ^d Measured from Fig. 18 of Lewis *et al.* (1974).

Table I. — Summary of measurements of topotypes of *P. fantalensis* (male) and *P. gibliensis* (male & female) compared with original description (holotypes & paratypes). Measurements (mm) and ratios shown are mean, standard deviation and range.

of the above important features and measurements were omitted. The twisted appearance of the spermathecal ducts shown in the figure of Lewis *et al.* (1974) is not characteristic but could happen during dissection or mounting possibly due to the delicate, thin-walled and expanded nature of the spermathecal ducts.

Male

In the original description, Lewis *et al.* (1974) stated to have measured five of 12 males collected, but they gave a single value for all characters except the palpal formula. However, most values were within the ranges of the present observation, but some differences were noted in body length and the palpal formula (see Table D).

Of the omitted characters in the original description of the male, the most important features were those of the aedeagus as they distinguish it from the male *P. fantalensis*. Aedeagus is 0.17 ± 0.09 (0.16-0.18) mm long, 7.48 ± 0.65 (6.96-8.57) times as long as its width which is 0.023 ± 0.001 (0.02 ± 0.024) mm at about the middle. It is much broader and more pigmented than that of *P. fantalensis*. It is also much more parallel-sided than in *P. fantalensis*, ending with a slightly up-turned and paler tip (Fig. 2C & D).

The single male from Metahara showed minor differences from the type forms and the topotypes (Table D), but the shape, coloration and thickness of the aedeagus were consistent.

DISCUSSION

The females of *P. fantalensis* and *P. gibliensis* are very similar to each other as are their males; they are indistinguishable by most morphological characters and measurements (Table D) except their genitalia. In gross appearance, the females of the two species also have very similar spermathecae, but can be distinguished by the morphology and dimension of the spermathecal ducts and bases. In *P. fantalensis*, the spermathecal ducts are much thinner and shorter than those of *P. gibliensis*. Furthermore, the openings of the duct bases in *P. fantalensis* are much narrower than they are in *P. gibliensis*. These differences are so obvious in well cleared and whole-mounted specimen that they can even be recognised during routine identifications without the need to dissect out the spermathecae.

The males of the two species can also be distinguished by the colour, shape, and dimensions of the aedeagus; no other character or measurement separates the two.

The identification of the females of most members of

the subgenus *Larrousius* in general was problematic until Léger *et al.* (1983) discovered the spermathecal ducts and bases to be of value in distinguishing some of the species of the Mediterranean region. This was subsequently confirmed in several other species of the subgenus in the Mediterranean region and Africa (Killick-Kendrick *et al.*, 1991; 1993a, b; 1994). Both *Phlebotomus fantalensis* and *P. gibliensis* are among the seven species of the subgenus *Larrousius* recorded in Ethiopia together with *P. ashfordi*, *P. orientalis*, *P. longipes*, *P. pedifer* and *P. aculeatus*. Killick-Kendrick *et al.* (1994) have already shown that the females of the latter four species can be distinguished by the morphology of the spermathecal ducts and/or bases. *Phlebotomus ashfordi* which has recently been described by Gebre-Michael and Lane (in press) also has distinct spermathecal bases and duct length. Both *P. fantalensis* and *P. gibliensis* also have very different spermathecal ducts and bases from the above species as well as from other species of *P. (Larrousius)* so far looked at (Léger *et al.*, 1983; Killick-Kendrick *et al.*, 1991). The present observation is also a further confirmation of the importance of the morphology of the spermathecal ducts and/or bases in the identification of *P. (Larrousius)* species.

Lewis *et al.* (1974) stated that *P. fantalensis* was very unlikely to be the male of *P. (Larrousius) somaliensis*, because the female of the latter and the male *P. fantalensis* were much less close in many characters. Our finding of a female which is not *P. somaliensis* proves this. The holotype female of *P. somaliensis* is the only representative of the species known from Somalia (Lewis, 1982).

Of the seven species of *P. (Larrousius)* found in Ethiopia, three are established vectors of *Leishmania* spp. in Ethiopia or elsewhere. *Phlebotomus orientalis* is a proven vector of *L. donovani* in the Sudan (Hoogstraal & Heyneman, 1969; Ashford *et al.*, 1992) and is strongly suspected in northwestern and southwestern parts of Ethiopia (Ashford *et al.*, 1973b; Gemetchu *et al.*, 1975; Hailu *et al.*, 1995). *Phlebotomus longipes* and *P. pedifer* are vectors of *L. aethiopica* in different foci in the Ethiopian highlands (Ashford *et al.*, 1973a; Laskay *et al.*, 1991); the latter is the only vector of the same parasite in Kenya (Kaddu and Mutinga, 1981; Sang and Chance, 1993). *Phlebotomus aculeatus* has been found naturally infected with *L. tropica* in Kenya (Johnson *et al.*, 1993), but it is as yet a poorly understood species in Ethiopia (Lewis *et al.*, 1974; Gemetchu *et al.*, 1990; Gebre-Michael & Lane, in press). Both *P. fantalensis* and *P. gibliensis* have recently been found outside their type localities (Gebre-Michael *et al.*, unpublished data) and investigations are underway on their possible role in the transmission of leishmaniasis in Ethiopia.

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