

Taxonomic Morphology of *Phlebotomus nuri* Lewis, 1967 (Diptera, Psychodidae, Phlebotominae) From Pakistan

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ABSTRACT

During entomological survey conducted by the author in the whole of the Balochistan Province, *Phlebotomus* (*Paraphlebotomus*) *nuri* Lewis (1967) was collected (n=09) from two localities. These localities appear to be new records of this species in the literature to date. ♀ *Phlebotomus nuri* was unknown in the literature from Pakistan. It has been recorded in Balochistan Province for the first time and is reported in the present paper. A detailed re-description of morphology of taxonomic characteristics of this species using three ♀ and four ♂ captured at Quetta and Khuzdar, is given here. Taxonomic features not previously described by earlier workers are also described and illustrated. The results are compared with the data available in the existing literature. Differential diagnosis of *Phlebotomus nuri* with its closest allies is also provided.

Key Words: Sandfly; *Phlebotomus nuri*; Taxonomic characteristics

INTRODUCTION

Phlebotomus nuri (♂) was first described by Lewis (1967) from Saidpur near Rawalpindi (Pakistan). He named this species in the honor of Lt. Col. Nur Ahmed ex. Associate Director, Pakistan Medical Research Center, who has done much to further the study of leishmaniasis in Pakistan. In fact, holotype of this species was collected by Professor H.C. Barnett (Former, Director of Institute of International Medicine, University of Maryland, Baltimore U.S.A) from Saidpur, near Rawalpindi, Pakistan on 21.v.1959. Later, it was identified by Lewis (1967) who furnished diagrams of male terminalia and cibarium but didn't supply the diagrams of wing, antennae, palps, pharynx, and genital pump of male. These structures as well as female form Pakistan were remained unknown in the literature prior to the present study. Similarly, Artemiev (1978) while describing females of this species from southern Afghanistan did not furnish figures of wing, antennae, palps, cibarium and female genitalia. In view of the in-sufficient descriptions of Lewis and Artemiev (*loc. cit.*), this species is re-described.

MATERIALS AND METHODS

During entomological survey conducted by the present author in the whole of Balochistan Province in 1996-2001, 2013 sandflies were collected comprising of the genera *Phlebotomus*, *Sergentomyia* and *Grassomyia* (Kakarsulemankhel, 2001). Flies were collected, processed, preserved, dissected and mounted according to conventional methods especially those followed by Johnson *et al.* (1963), Lewis (1973), Killick-Kendrick (1983), Lawyer *et al.* (1991) and Killick-Kendrick *et al.* (1994).

Standard keys furnished by Lewis (1967, 1978, 1982) and Artemiev (1978) were followed for identification of sandfly species. All the diagrams were drawn with a camera lucida and are to the given scale and the measurements are in millimeter.

Specimens are housed in the Author's Sandflies collections, Department of Zoology, University of Balochistan, Quetta.

RESULTS

***Phlebotomus* (*Paraphlebotomus*) *nuri* Lewis (1967)**

Phlebotomus (*Paraphlebotomus*) *nuri* Lewis, 1967: 15 [♂]; Artemiev, 1974: 160, 61; 1978: 17 [♀].

Female: Not described before from Pakistan. Three specimens were examined (Fig. 1). Wing 2.30 (2.24-2.36) long, 0.66 (0.64-0.68) broad, $\alpha=0.44$ (0.43-0.45) long, $\beta=0.34$ (0.33-0.35) long, $\delta=0.011$ (0.01-0.011), $\gamma=0.48$ long, $\pi=0.10$ (0.08-0.12), alar index=1.29 (1.28-1.30). Proboscis 0.31 (0.30-0.32) long, 0.134x length of wing. Palps 0.95 long, formula 1,2-4,3,5, with relative length 100:355:453:355:800, with about 15 spatulate Newstead's sensilla over middle third of segment 3, other palpal segments have none. A3 0.25 (0.23-0.27) long, 0.108x length of wing, 0.806x length of proboscis, 1.02x length of labrum, 1.063x length of A4+5, ascoid on A3 0.05 long, 0.2x length of segment. A4 (Fig. 1D, lower) 0.12 long, ascoid on A4 0.05 long, 0.416 x length of segment. A5 (Fig. 2D, upper) 0.115 (0.11-0.12) long, ascoid on A5 0.05 long, 0.434x length of segment. Antennal segments III, IV and V had a single papilla. The positions of the papilla on the segments were: A III, 0.869, A IV, 0.75 and A V, 0.8. The positions of the ascoids on the segments were: A III, 0.678, A IV, 0.416, and A V, 0.466.

There were two ascoids on segments III to XV. Labrum 0.245 (0.24-0.25) long, 0.106x length of wing, labrum with three apical, relatively long, stout sensilla and adorals small, sensilla depth 0.056. Hypopharynx with about 15 teeth at each side, with a dental depth of 0.048. Maxilla with four lateral and about 21 ventral teeth, dental depth of 0.096. Mandible narrow, 0.017 broad, with 7-8 small re-curved teeth per 0.01, and dental depth 0.056. Cibarium 0.04 broad, chitinous arch developed, ventral plate convex, cibarium with 7-9 minute dot like denticles at anterior central region whereas 4-8 relatively long spicules at sides, pigment patch and anterior process both absent. Pharynx 0.225 (0.22-0.23) long, pharynx was 2.5 (2.30-2.75) times as long as its greatest posterior portion which was 1.5 times broader its anterior narrow part, most of the broad part of the pharynx was occupied by pharyngeal armature. The anterior edge formed an almost straight line. The median and posterior part of the armature was in blunt, long and wide teeth directing obliquely down to the center whereas the basal part was composed of fine curved or straight punctiform ridges. Female genitalia: spermatheca 0.027 (0.026-0.028) long, 7-8 segments, anterior segments 0.012 broad, median segments 0.016 broad and basal segments 0.012 broad, spermathecal ducts 0.192 long, 0.004 broad, ducts with conspicuous transverse striations and with separate openings into genital atrium which was 0.052 broad. The shape of the base of duct was like an asymmetrical bell. Genital furca 0.088 long.

Male: Four specimens were examined (Fig. 2). Wing 2.0 long, 0.56 broad, head 0.44 long, 0.464 broad, eye 0.176 long, 0.144 broad, distance between eyes 0.128. $\alpha=0.32$ long, $\beta=0.24$ long, $\delta=0.064$ long, $\gamma=0.32$ long, $\pi=0.064$, alar index=1.33. Proboscis 0.27 (0.26-0.28) long. Palps 0.84 long, formula 1,4,2,3,5 with relative length 100:35:45:30:90, P3 has 8-10 spatulate Newstead's sensilla over the middle of the body, other palpal segments have none. A3 0.29 (0.27-0.31) long, 0.145x length of wing, 1.0x length of proboscis, 1.348x length of labrum, 1.115x length of A4+5, ascoid on A3 at 0.709, 0.45 (0.04-0.05) long, and was 0.155x length of segment. A4 (Fig. 2D, lower) 0.13 (0.11-0.15) long, ascoid on A4 at 0.33, 0.042 (0.04-0.044) long, and was 0.323 of length of segment. A5 (Fig. 2D, upper), 0.13 (0.11-0.15) long, ascoid on A4 at 0.346, 0.042 (0.04-0.044) long, and was 0.323 of the length of segment. There were two ascoids on segments III to XV. Labrum 0.215 (0.21-0.22) long, with 3 long apical sensilla and adorals were small, sensilla depth of 0.052. Hypopharynx 0.022 broad with about 14 teeth on each side and a dental depth of 0.032. Cibarium 0.04-0.045 broad, chitinous arch developed, pigment patch and anterior process absent, cibarium was armed with many relatively long lateral spicules and minute scattered denticles. Pharynx 0.19 long, and was 2.53 times as long as broad, with hind width 1.75 times fore width, height of armature 0.05 mm and was 0.263x length of the pharynx. The anterior edge of pharyngeal teeth formed an almost straight line. The anterior

Fig. 1. *Phlebotomus nuri* (♀) wing (A), palps (B), the third (C), fourth (D, lower), and fifth (D, upper) antennal segments, labrum (E), hypopharynx (F), maxilla (G), mandible (H), cibarium (I), pharynx (J), spermatheca (K), ducts (L), genital atrium (M), duct base (N), and genital furca (O)

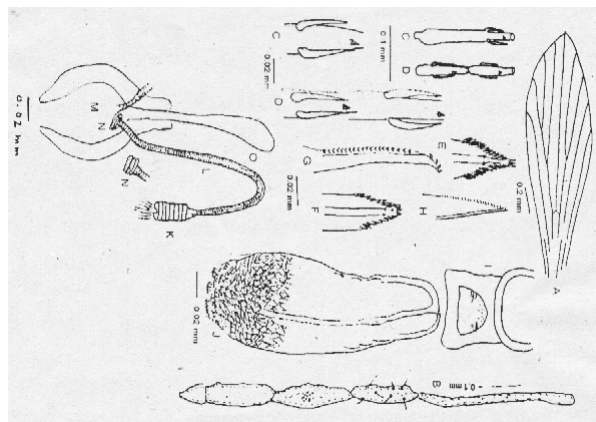
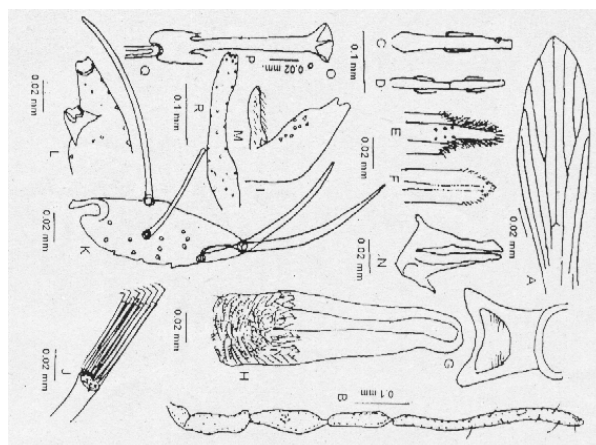


Fig. 2. *Phlebotomus nuri* (♂) wing (A), palps (B), the third (C), fourth (D, lower), and fifth (D, upper) antennal segments, labrum (E), hypopharynx (F), cibarium (G), pharynx (H), coxite (I), basal process (J), style (K), tubercles of style for apical and sub apical spine (L), paramere (M), aedeagus (N), genital funnel (O), pump (P), filament (Q) and surstyle (R)



central part was composed of long spicules directing obliquely down towards center as well as there were short but broad teeth. The posterior and basal region consists of straight and curved rows of punctiform ridges. Male genitalia: coxite 0.22 (0.20-0.23) long, 1.466x length of style, 0.09 mm broad. The head of basal process 0.024 mm broad with long hair, distal part of the hairs were characteristically curved downward at 90° , neck of the basal process 0.02 broad. Style slender 0.15 mm long, 0.04 broad, style 3.75 times as long as wide. Style with 4 spatulate spines, 1 apical, 1 sub apical and 2 median spines, apical spines 0.11 long, stands on a large tubercle (0.04 long) and 1 sub apical spine 0.115 long, stands on a shorter tubercle (0.02 long) at 0.666 of the length of the style, both median

spine were at 0.4 of the style, the median short thin spine 0.09 long whereas the median, thick longer spine 0.14 long. Paramere 0.13-0.14 long, with flat elliptical upper surface bearing many short erect hairs. Aedeagus 0.07-0.08 long, apical ends almost straight but in few specimens very slightly curved ventrally, the shank of the aedeagus was chisel shaped. Genital funnel 0.056 long and 0.028 broad, genital pump 0.17-0.18 long, and filament 0.23-0.24 long, F/P=1.33-1.35. Surstyle very long (0.34 long), 1. 545 x length of coxite.

Differential diagnosis of *Phlebotomus nuri*. The morphology of cibarium and pharynx and height of pharyngeal armature, length of antennae, ascoid 4/A4, ascoid formula and papilla formula are important diagnostic characters in both sexes. In the male, the position of the apical and sub apical spines on the style, style length/breadth of style, length of surstyle and shape of hairs of head of basal process of coxite and aedeagus are also useful aids in identification. *Ph. nuri* is the only Oriental species with a large lobe on the coxite (Lewis, 1978).

This species differs from the other *Paraphlebotomus* species recorded from Balochistan as follows:

Ph. sergenti (♀) has antenna 3 long (0.263-0.30), 0.967-0.992x length of labrum, pharynx with uniform strong teeth directed obliquely down to the center and 4 or 5 segments in the spermathecae with broad apical segment. Shorter style (0.09-0.107) with 2 apical spines, basal process with asymmetrical thin head directed obliquely down, genital pump long (0.16-0.193) with broad funnel are useful diagnostic characters in the identification of ♂ of this species.

Ph. alexandri has a much shorter wing length, much shorter A3, shorter pharynx and a shorter height of pharyngeal armature in both sexes. Pharynx and pharyngeal teeth have quite different morphology: the pharynx is conical and is more dilated posteriorly. In ♂ also, the shape of hairs of the head of basal process, shape of style, shorter genital pump, shorter surstyle and slightly curved apical ends of aedeagus are important diagnostic characters. In the ♀, spermathecal ducts are without transverse striations.

Ph. andrejevi (♂) can be easily recognized by having symmetrical large, broad head (0.036) and broad neck (0.026) of the basal process with short hairs, and short style (0.1-0.14 long) with terminal spines standing on tubercles of similar length.

Distribution: Balochistan. New Record, Present survey: Quetta, Khuzdar. These localities are important foci of cutaneous leishmaniasis. Flies were collected using sticky traps from mud walls of residential quarters on 29.x.2000 and 23 .iii. 2001. Punjab: Saidpur near Rawalpindi (Lewis, 1967). Afghanistan: southern Afghanistan (Artemiev, 1978).

DISCUSSION

Results of the present study are compared with the published data of *Ph. nuri* from Rawalpindi, Pakistan (Lewis, 1967) and Afghanistan (Artemiev, 1978) (Table I & II).

Table I. Comparison of taxonomic characters (in mm) of female *Phlebotomus nuri* Lewis

Taxonomic characters	Balochistan (Pakistan) (Present study)	Afghanistan (Artemiev, 1978) (in micron)
Wing		
Length	2.30 (2.24-2.36)	
Length/width	3.48 (3.393-3.575)	3.69 (3.53-3.8)
Wing index	1.29 (1.28-1.30)	1.54 (1.29-1.82)
A3		
Length	0.25 (0.23-0.27)	279 (264-296)
A3 / labrum	1.02	0.77 (0.71-0.84)
A3 / A4+5	1.063	1.15 (1.1-1.21)
Ascoid 4 / A4	0.416	0.46 (0.45-0.48)
Labrum Length	0.245 (0.24-0.25)	361 (344-372)
Maxilla	With four lateral and about 21 ventral teeth	With 5-6 lateral teeth, 17(14-19) ventral ones
Palp		
Length	0.95	1069 (996-1116)
Formula	1,2-4,3,4,5	1,4,2,3,5
Average relation of palpal segments	10:35:45:35:80	10:35:41:29:78
Cibarium	Cibarium with well developed chitinous arch and small denticles	Cibarium with well developed with chitinous arch and small vertical denticles
Pharynx		
Length	0.225 (0.22-0.23)	248 (232-260)
Length / width	2.5 (2.30-2.75)	3.14 (2.1-3.32)
	pharyngeal armature occupies 0.293-0.295x length of pharynx, pharyngeal armature directed obliquely down to the center	pharyngeal armature occupies 0.31 (0.29-0.33)x length of the pharynx, pharyngeal armature directed obliquely down to the center
Spermatheca	7-8 segments with narrow apical segments	7-8 segments with narrow apical segments

Ph. nuri (♀) of Balochistan have a relatively shorter wing length, length/width ratio, wing index, A3, A3/A4+5, ascoid 4/A4, labrum, palp, pharynx length, length/width of pharynx as compared with that of Afghanistan. However A3/Labrum in Pakistani specimens was found to be slightly greater as that from Afghanistan. Pakistani specimens were observed in full accordance with Afghanistan specimens in diagnostic characters like cibarium, and spermathecae with 7-8 segments. *Ph. nuri* (♂) from Balochistan were observed having slightly shorter wing length, breadth, wing index, labrum A3, A3/A4+5, coxite, head of basal process of coxite, style length genital filament/pump ratio and length of surstyle as compared with the data of this species reported from Rawalpindi. Characters like A3/Labrum and ascoid 4/A4 in specimens from Balochistan were found to be slightly greater with that of the data of specimens from Rawalpindi.

Table II. Comparison of taxonomic characters (in mm) of male *Phlebotomus nuri* Lewis

Taxonomic Characters	Balochistan (Pakistan) (Present study)	Rawalpindi, Pakistan (Lewis, 1967)	Southern Afghanistan (Artemiev, 1978) (micron)
Wing			
Length	2.0	2.30 (2.08-2.52)	-
Breadth	0.56	0.62 (0.56-0.69)	
Wing index	1.33	1.5 (1.3-1.7)	
A3			
Length	0.29 (0.27-0.31)	0.33 (0.31-0.37)	279 (264-296)
A3 / labrum	1.348	1.1	0.77 (0.71-0.84)
A3 / A4+5	1.115	1.2	1.15 (1.1-1.21)
Ascoïd 4 / A4	0.323	0.25	0.46 (0.45-0.48)
Ascoïd formula	2/3-15	2/3-15	
Labrum Length	0.215 (0.21-0.22)	0.30 (0.28-0.34)	361 (344-372)
Cibarium	With lateral spicules and several small pointed denticles, chitinous arch developed, pigment patch absent	With lateral spicules and several small pointed scattered denticles, chitinous arch developed	1069 (996-1116) 1,4,2,3,5 10:35:41:29:78
Pharynx	Long spicules directing obliquely down to the center and rows of punctiform ridges.	Transverse scale like ridges and posterior rows of minute denticles.	Cibarium with well developed with chitinous arch and small vertical denticles
Coxite			
Head of basal process	0.22 (0.20-0.23) 0.024 broad	0.30 (0.28-0.34) 0.03 broad	Basal process of coxite long and thick with very long hairs
Style	0.15 mm long, 3.75 times as long as wide, sub apical spine at a shorter tubercle at 0.666 of the length of style, median thin spine is at 0.4 of the style	0.17 (0.16-0.19), about 4 to 6 times as long as its own width, sub apical spine at a shorter tubercle at 0.8 of the length of style, median thin spine is at 0.4 of the style.	Style long, sub terminal spine is at 0.85-0.95 of style.
Aedeagus	With blunt ends	With blunt ends	-
Genital pump			
Length	0.17-0.18	About 0.17	-
F / P	1.33-1.35	1.56	-
Surstyle Length	0.34	0.35 (0.32-0.39)	-

CONCLUSION

The present results reveal that *Ph. nuri* is a very rare species (9/2013, 0.45%) with a localized and discontinuous distribution. There are no published reports incriminating *Ph. nuri* which is thought to be thermophilic and moderately hydrophilic (Artemiev, 1978) and presumably plays no part in transmitting *Leishmania* to man.

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