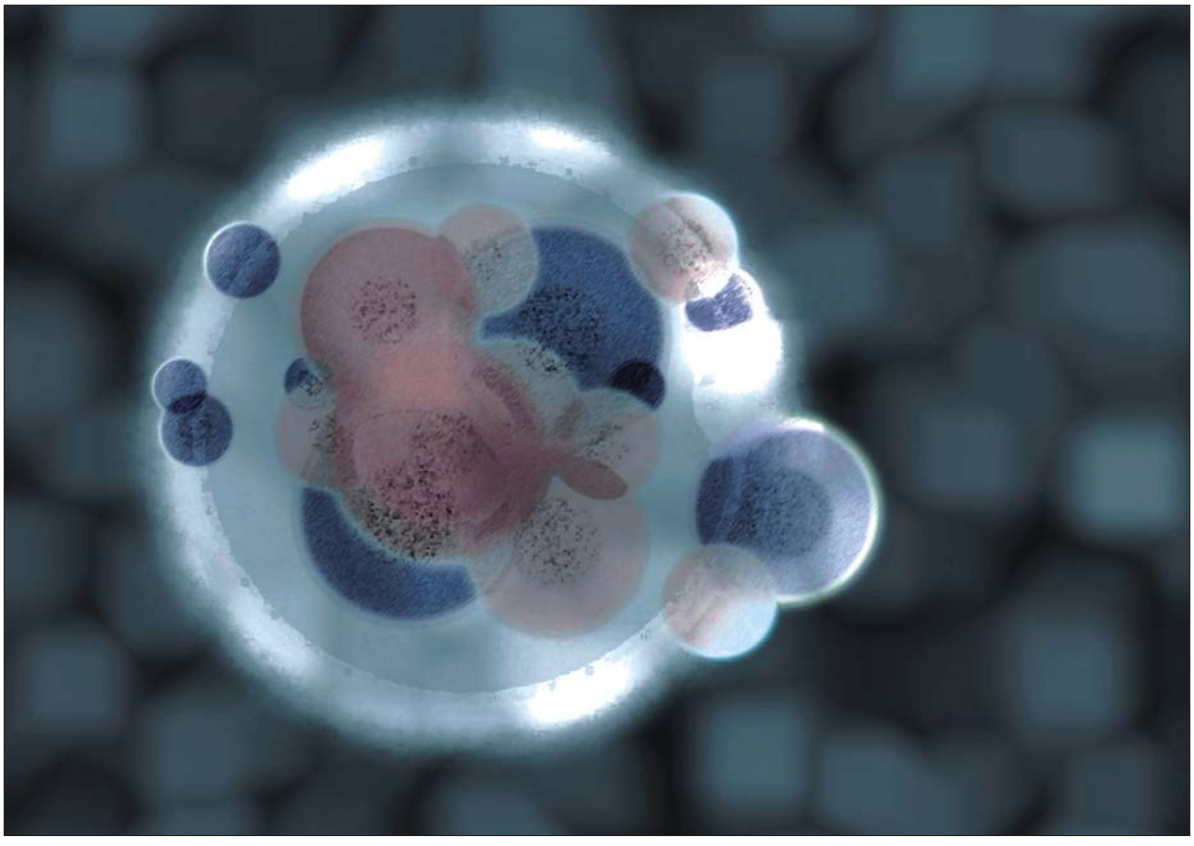

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Taxonomic Morphology of *Sergentomyia (Sergentomyia) theodori pashtunica* Artemiev (1974) (Diptera, Psychodidae) from Pakistan

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Abstract: During entomological surveys conducted in the whole of Balochistan Province *Sergentomyia (Sergentomyia) theodori pashtunica* Artemiev (1974) was collected (N=158) from 13 localities. These localities appear to be the new record of this species in the literature to date. Taxonomic morphology previously not described by earlier workers are also described, measured and illustrated in the present study. Results of Balochistan specimens are compared with the published data available in the existing literature from other territories. Differential diagnosis of this species is also given.

Key words: Sandfly, *Sergentomyia theodori pashtunuica,* taxonomic characters

INTRODUCTION

Sergentomyia theodori, Parrot[1] was originally described by Adler and Theodor[2] as *Ph. minutus* from Palestine. Sinton[3] found it in NW India and pointed out that females of Indian species of *Ph. minutus* have long 3rd antennal segments (more than 90 micron) and with no deep notch on posterior border of pharynx. Sinton[4] also stated that ♂ of *Ph. minutus* have third antennal segment longer (about 120 micron) and more than ½ length of proboscis, pharynx not markedly expanded posteriorly, buccal armature larger and paramere with blunt end. *S. theodori* was reported from Pakistan except south western Pakistan, Balochistan province, by Lewis[5]. Thereafter Lewis[6] treated it as a synonym of *S. t. pashtunica* Artemiev[7] on the ground of fewer cibarial teeth (22=18-24) and shorter labrum (0.14=0.13-0.165 mm) of female than the nominate form and in the male differs by having a shorter labrum (0.12-0.14 mm) and a shorter antenna 3 (0.10-0.11 mm). Lewis[5] while reporting *S. theodori* from Pakistan, did not describe measurements of head, eye, proboscis, palps, hypopharynx, maxilla, mandible, cibarium, pharynx, male terminalia and female genitalia nor sketched wing, palp, antennal segments, labrum, hypopharynx, maxilla, mandible, cibarium, pharynx, male terminalia and female genitalia. Artemiev[7] while describing *S. theodori pashtunica* from eastern Afghanistan did not furnish measurements of hypopharynx, maxilla, mandible, spermatheca, ducts, furca, genital atrium nor supplied diagrams of wing, palp, antennal segments, labrum, hypopharynx, maxilla, mandible, coxite, genital filament, pump and female genitalia. Aslam[8] reported it from Dera Bugti but taxonomic characters were neither described, measured nor even figured.

Therefore, to fill the aforementioned gap of knowledge, a taxonomic study for identification of the species of sandflies prevalent in the Balochistan province was conducted by the present author during 1996-2001 and 2013 sandflies comprising genera *Phlebotomus, Sergentomyia* and *Grassomyia* were collected[9]. In view of the insufficient descriptions of Artemiev, Aslamkhan, Lewis, Parrot, Sinton (*loc.cit.*), *Sergentomyia* (*Sergentomyia*) *theodori pashtunica* is redescribed in detail in the present study. Taxonomic morphology not described by earlier workers are also described, measured and illustrated here.

MATERIALS AND METHODS

For collection, processing, preservation, dissection, mounting of the specimens and observation of external and anatomic parts of the sandflies, the conventional techniques especially those used by Johnson *et al.*[10-14] were followed. For the species identification of sandflies, keys furnished by Artemiev[15] and Lewis[5,6] were consulted. Measurements are in millimeter (mm). All the diagrams were drawn with the camera lucida and are to the given scales. Specimens are housed in the Author's collection of Sandflies, Department of Zoology, University of Balochistan, Quetta.

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RESULTS

Sergentomyia (Sergentomyia) theodori pashtunica Artemiev[7].

Phlebotomus minutus Rondani, Sinton[3], Indian J. Med. Res., 20:61,73[4], Indian J. Med. Res., 21: 421. *Sergentomyia (Sergentomyia) theodori* Parrot, Lewis[5], Bull. Brit. Nat. Hist (Ent.), 19: 27. *Sergentomyia (Sergentomyia) theodori pashtunica* Artemiev[7], Medskaya Parazit., 43: 333, Artemiev[15], 26, Lewis[6], Bull. Brit. Mus. Nat. Hist. (Ent.), 37: 255. [Lewis treated *S. theodori* Parrot as a synonym of *S.t. pashtunica* Artemiev].

Female: Thirty five specimens were examined (Fig. 1). Head 0.28-0.29 mm long, 0.256-0.272 mm broad. Eye 0.144-0.152 mm long, 0.08-0.09 mm broad and distance between eyes 0.096-0.1 mm. Wing (Fig. 1A) very narrow, 1.20-1.30 mm long, 0.264-0.28 mm broad, α=0.12-0.15 mm long, β=0.176-0.23 mm long, δ=0.04-0.056 mm, in three specimens from Bela, delta was observed to be zero, γ=0.24-0.28 mm, π=0.024-0.05 mm, in two specimens from Bela and two from Khuzdar, π was observed to be zero, alar index= 0.652-0.681. Palps (Fig. 1B) 0.43-0.52 mm long, palpal ratio 1: 2.41: 4.08: 3.68: 8.66 and formula 1, 2, 4, 3, 5. Newstead's sensilla are situated on the basal third of segment 3 and number about 15-25. Proboscis 0.14-0.155 mm long. A3 (Fig.1C) 0.07-0.09 mm long, 0.058-0.69xlength of wing, 0.5-0.58x length of proboscis, 0.636-0.692xlength of labrum, ascoid on A3 0.02 mm long, 0.222-0.285xlength of segment. A4 (Fig. 1D, lower) 0.05-0.054 mm long, ascoid on A4 0.02 mm long, 0.37-0.4xlength of segment. A5 (Fig. 1D, upper) 0.052-0.056 mm long, ascoid on A5 0.02 mm long, 0.357-0.381xlength of segment. Antennal segments III and IV have a single prominent papilla (Fig. 1C-1D). On both it was usually by the side of the ascoid, but is occasionally anterior or posterior to it. AIII is shorter than AIV+A5 (aboutx0.0686-0.818). The positions of the papilla on the segments are: AIII, 0.833 and AIV, 0.614. The positions of the ascoids on the segments are: AIII, 0.685, AIV, 0.39 and AV, 0.369. There are two ascoids on segments III to XV. Labrum (Fig. 1E) 0.11-0.13 mm long, with three apical sensilla, relatively stout, lateral sensilla fine, a sensilla depth 0.024 mm. Hypopharynx (Fig. 1F) apical and lateral margins of hypopharynx strongly undulating, apical margin 0.005 mm broad, a dental depth of 0.022 mm, four teeth per 0.004 mm. Maxilla (Fig. 1G) 0.009 mm broad, four lateral and 23 ventral teeth, 4 teeth per 0.008 mm, a dental depth of 0.06 mm. Mandible (Fig. 1H) narrow, 0.008 mm, broad with small fine re-curved teeth, 6 teeth per 0.004 mm, a dental depth of 0.048 mm. Cibarium (Fig. 1I) 0.04-0.045 mm broad, 17-20 teeth arranged on an arc (6-7 lateral, sharply pointed, larger teeth, each about 0.004 mm long and at each side -6 central smaller teeth, each about 0.002 mm long), bases of the teeth without punctiform denticles below these teeth is a dark colored curved pigment patch of about 0.022-0.026 mm long and 0.012-0.014 mm broad, without anterior process, chitinous arch ill developed at center but more developed at sides. Pharynx (Fig. 1J) 0.11-0.124 mm long, much dilated posteriorly, length about 2 times greatest breadth which is about 3.3 times the width of narrow anterior portion. Armature yellow pigmented and occupies the posterior 0.26-0.27 of the pharynx. The anterior edge formed a sharply curved line, anterior armature was in the form of long horizontal straight lines about 0.016-0.018 mm long and posterior part of armature is about 0.009-0.013 long and composed of small punctiform denticles, hind margin with medial slight depression. Spermatheca (Fig.1K) tubular, capsule relatively larger, 0.032-0.035 mm long, 0.021-0.22 mm broad, passing without any boundary into a short individual duct (Fig. 1L) (0.032 mm long and 0.012 mm broad), joining with a common duct (Fig. 1M), furca 0.072 mm long and genital atrium (Fig. 1N) 0.04 mm broad.

Male: Seven specimens were examined (Fig. 2)). Wing (Fig. 2A) 1.28-1.36 mm long, 0.264-0.288 mm broad, α=0.12-0.144, β=0.2-0.232 mm, δ=0.04-0.56, γ=0.28-0.304 mm, π=0.08-0.096 mm, alar index=0.6-0.62. Palp (Fig. 2B) total length 0.45-0.54 mm, palpal ratio 1:7:11, 12.5: 17, palp formula 1, 2, 3, 4, 5. Proboscis 0.13-0.14 mm. A3 (Fig. 2C) 0.11-0.12 mm long, ascoid 0.016-0.018 mm, position of ascoid 0.61, ascoid 3/A3=0.145-0.15, position of a single papilla on A3 0.768. A4 (Fig. 2D, lower) 0.07-0.08 mm, ascoid 0.016-0.018 position of ascoids on A4 0.28, ascoids 4/A4=0.225-0.228, position of a single papilla on A4 0.677. A5 (Fig. 2D, upper) 0.76-0.08 mm long, ascoid 0.016-0.018 mm, position of ascoid on A5 0.25, ascoid 5/A5=0.21-0.22, position of a single papilla on A5-0.55 (N=2). There is a single ascoid on segments III to XV. A3/Labrum=1.09-1.1, A3/A4+5=0.75, A3/Proboscis=0.846-0.857. Labrum (Fig. 2E) 0.10-0.11 mm long with a sensilla depth of 0.026 mm. Hypopharynx (Fig. 2F) 0.012 mm broad with pointed apex and dental depth of 0.02 mm. Cibarium (Fig. 2G) 0.042-0.046 mm broad, with 14-16 teeth, the central teeth shorter than the lateral ones and are arranged in a concave line, chitinous arch ill developed. Pharynx (Fig. 2H) 0.11-0.12 mm long and the widest posterior portion being about 1.45 times as broad as the narrower anterior part and the length is nearly 3.28 times the greater breadth. The armature consisted of very numerous weak transverse rows.

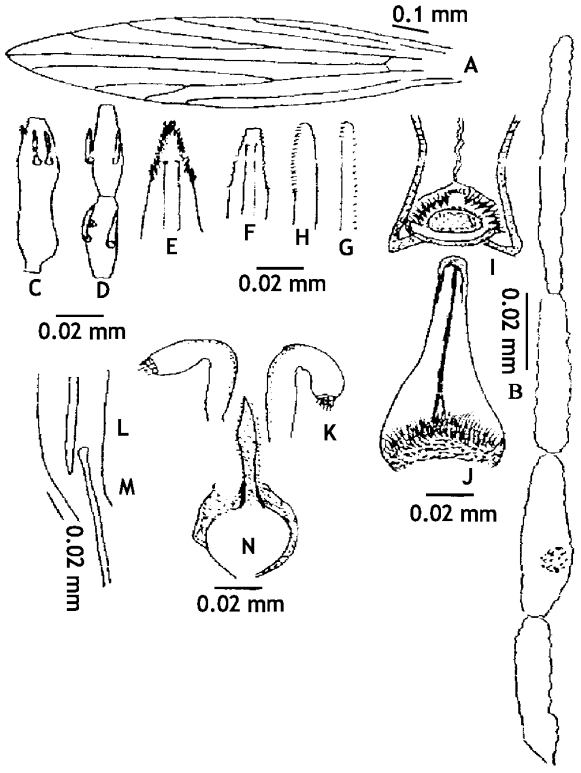

Fig. 1: Camera Lucida drawings of *S. theodori pashtunica* (♀) showing: wing (A), palps (B), the third (C), fourth (D, lower) and fifth (D, upper) antennal segments, labrum (E), hypopharynx (F), maxilla (G), mandible (H), cibarium (I), pharynx (J), spermatheca (K), individual duct (L), common duct (M), genital atrium (N)

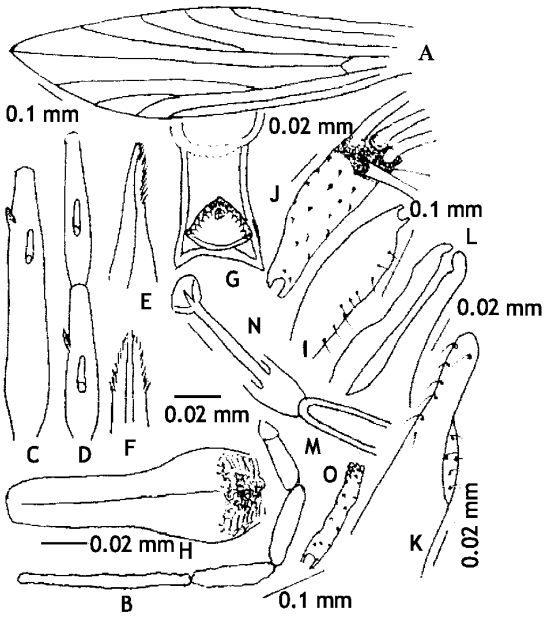

Fig. 2: Camera Lucida drawings of *S. theodori pashtunica* (♂) showing: wing (A), palps (B), the third (C), fourth (D,lower) and fifth (D,upper) antennal segments, labrum (E), hypopharynx (F), cibarium (G), pharynx (H), coxite (I), style (J), paramere (K), aedeagus (L), genital filament (M), pump (N), surstyle (O)

Coxite (Fig. 2I) 0.21-0.22 mm long, 0.06-0.068 mm broad and 9-12 ventrally directed hairs sparsely distributed on the ventro-lateral surface of coxite, coxite/A3=1.90-2.0, coxite/labrum 2.0-2.1, coxite/style=2.62-2.75. Style (Fig. 2J) 0.08 mm long, 0.024 mm broad, with four terminal spines, spines longer (0.1 mm) than style and spatulate, seta 0.026 mm long and at 0.9 of the style. Paramere (Fig. 2K) 0.12 mm long, about 0.58% part of the paramere is 0.036 mm broad and 0.42% part of the body was 0.01 mm broad, with blunt and rounded end, a ventral tubercle with 3-5 short hairs is at 0.5 of the paramere. Aedeagus (Fig. 2L) 0.08-0.10 mm long one half of the Aedeagus was 0.012 mm broad, both halves of aedeagus is 0.024 mm broad and have a sub apical tubercle at 0.96 of the aedeagus. Genital filament (Fig. 2M) 0.28-0.30 mm long, smooth, pump (Fig. 2N) 0.07-0.09 mm long, with filament to pump ratio of 3.33-4.0. Surstyle (Fig. 2O) 0.17-0.19 mm long and 0.80-0.86xlength of coxite.

Distribution: Baluchistan. New Record, Present survey: Bela, Dashte Kuddan, Duki, Kahan, Khuzdar, Kohlu, Nanasaheb ziarat, Panjgour, Parom, Sibi, Tump,Turbat, Uthal. These localities are important foci of cutaneous leishmaniasis. Sandflies were collected using mouth aspirators and sticky traps from indoors and outdoors. Dera Bugti[8].

DISCUSSION

Results of the present study were compared with the published data of *S. theodori pashtunica* Artemiev[7] from other territories (Table 1). ♀ specimens of this species from Balochistan do show a relatively slightly shorter wing, shorter A3, A3/ labrum and ascoid 4/A4 as compared with that of specimens from Peshawar[5] and also a shorter ratio of pharynxlength/width as compared with that of from specimens from Afghanistan[7] but a larger alar index as that from Peshawar. However, Pakistani specimens do show resemblance in characters like A3 (as that from N.W.F.P, reported by Sinton[3]), A3<A4+5, palpal formula (as that from Peshawar reported

Table 1: Comparison of taxonomic characters (in mm) of *S. theodori pashtunica*

♀ Taxonomic characters	Balochistan (Present study)	Peshawar Lewis[5]	Afghanistan Artemiev[15] (in um)
Wing length	1.2-1.3	1.5 (1.43-1.57)	
breadth	0.264-0.28	0.3 (0.27-0.32)	
alar index	0.652-0.681	0.6 (0.4-0.8)	-
A3 length	0.07-0.09	0.11 (0.10-0.11)	
A3 / A4+5	A3<A4+5 (0.686-0.818)	A3<A4+5	
A3 / labrum	0.636-0.692	0.7 (0.7-0.9)	-
Labrum length	0.11-0.13	0.15 (0.14-0.16)	-
Ascoid 4 / A4	0.37-0.4	0.4	-
Palp formula	1,2,4,3,5	1,2,4,3,5 or 1,2 (3-4),5	-
Cibarium	11-13 teeth, more shorter in center, pigment patch without anterior process.	-	17-22 teeth, more shorter in the center, pigment patch without anterior process.
Pharynx	Length / breadth = 2.0, armature consists of long pigmented teeth, base of the pharynx with a single medial depression.	-	Length / breadth=2.0-2.6, base of the pharynx with no deep notch or straight, pharyngeal armature consists of rather longer pigmented teeth.
♂ Taxonomic characters			
A3 length	0.11-o.12	No description of male fly from	128-156
A3 / labrum	1.09-1.1	west Pakistan was given	1.03-1.19
A3 / proboscis	0.846-0.857	by Lewis (1976:27).	
Ascoid 4/ A4	0.225-0.228	-	0.22-0.25
Cibarium	14-16 teeth, central teeth shorter than the lateral ones.	-	17-22 teeth, more shorter in the center.
Coxite length	0.21-0.22		228-252
Coxite / A3	1.90-2.0		1.56-2.0
Coxite / labrum	2.0-2.1	-	1.84-2.07
Style	With 2 apical spines and 2 sub apical	-	With 2 spines terminal and 2 sub terminal
Paramere	With blunt ends	-	-

by Lewis[5]), morphology of cibarium and pharynx. However, ♀specimens of the present study are found having fewer cibarial teeth (17-20) and a shorter labrum (0.11-0.13 mm) than the nominate form and also the ♂ specimens were observed with a shorter labrum (0.10-0.11 mm) and a shorter antenna (0.11-0.12 mm). These taxonomic characters are found in full accord with the description given by Lewis[6]. Specimens of the present study are also found to be in full accord with the published data of Afghanistan specimens[15] in characters viz., coxite / A3, coxite / labrum and paramere with blunt ends.

Differential diagnosis of *S. theodori pashtunica*. Shorter A3 (0.07-0.09 mm), 0.636-0.692xlength of labrum, labrum (0.11-0.13mm), ascoid 4/A4=0.37, morphology of cibarium, (fewer cibarial teeth 17-20 arranged on an arc with convexity anteriorly, 7-8 larger lateral teeth with sharp longer points, on each side and 5-6 central small teeth) and pharynx (base of pharynx 3.3 times as wide as apex and length of pharynx/ breadth=2.0, base of pharynx with a very little median notch, morphology of mouth parts (Maxilla with 4 lateral and 23 ventral teeth, 4 teeth per 0.008 mm, a dental depth of 0.06 mm, Mandible narrow, 0.008 mm broad, 6 teeth per 0.004 mm, a dental depth of 0.048 mm, Hypopharynx with apical margin smooth, 0.005 mm broad, lateral margins undulating and a dental depth of 0.002 mm) and tubular spermatheca (0.032 mm long, 0.016 mm broad) are usefull diagnostic characters in the identification of female of this species.

However, *S. theodori pashtunica* Artemiev, differs from the other related species of the subgenus *Sergentomyia* in the following characters:-

a) *S. murghabaiensis* (♀) has a slightly greater wing length (1.28-1.30 mm) and antenna 3 (0.084-0.11 mm), A3/labrum=0.84-1.1, ascoid 4/A4=0.38-0.4, a slightly shorter cibarium breadth, 16-20 large uniform teeth fused or placed at some distance with short points on a line slightly convex anteriorly, pigment patch with a short anterior process, base of the pharynx 2.82 times as greater as apex, straight base of pharynx and tubular spermathecae. Further, the following diagnostic characters are found important in the identification of *S. murghabiensis* (♀) in comparison with *S. theodori pashtunica* :-

i. maxilla with 3 lateral and 31 ventral teeth and a dental depth of 0.064 mm,
ii. mandibles narrow with 8 re-curved teeth per 0.008 mm and a dental depth 0.065 mm,
iii. hypopharynx with about 14 teeth at both sides, dental depth of 0.028 mm.

However, *S. murghabiensis* (♂) can be distinguished by other species including *S. theodori pashtunica* in characters having A3 = 0.11-0.13 mm long, A3/labrum = 1.08-1.22, A3/A4+5 = 0.78-0.85, labrum = 0.09-0.12 mm long, ascoid 4/A4=0.25-0.266, cibarium with 11-15 uniform small teeth arranged on a

slightly concave line, phaynx was about 3.15 times as long as broad and its widest posterior portion is 1.72 times as wide as the narrowest anterior part, coxite/A3=1.53-1.63, coxite/labrum=1.66-2.0, coxite/style =2.25-2.5 and both parts of aedeagus are 0.028 mm broad.

b) *S. punjabiensis* (♀) can be recognized and separated from *S. theodori pashtunica* by a relatively longer (0.336 mm) and broader (0.368 mm) head, a relatively shorter 1.16 (1.12-1.20 mm) and narrower (0.285 mm) wing, a larger ascoid 4/A4 (0.425), a relatively broader (0.058-0.06 mm), cibarium about 28 uniform teeth arranged on a line convex anteriorly, pigment patch 0.034 mm long , 0.02 mm broad, a relatively more wider base of pharynx with a deep median notch, base of pharynx 3.68 times as wide as apex, spermathecae tubular (anterior breadth=0.04 mm, posterior breadth=0.024 mm). Further, extra diagnostic character are as under:

i. maxilla with 5 lateral and 23 ventral teeth and a dental depth 0.06 mm
ii. hypopharynx with 14 teeth at each side and a dental depth 0.032 mm
iii. mandibles 0.018 mm broad with 5-6 re-curved teeth per 0.01 mm and a dental depth of 0.064 mm.

c) *S. mervynae* (♀) has narrower wings (0.264-0.28 mm broad), relatively longer β (0.20-0.26 mm), shorter labrum (0.11 mm), broader mandible (0.008 mm), a larger dental depth (0.024 mm) of hypopharynx, relatively larger A3 (0.09-0.10 mm), a larger A3/labrum (0.818-0.909), narrower cibarium (0.04 mm broad), 16 cibarial teeth, differentiation among central and lateral teeth are less obvious than teeth of *S. theodori pashtunica* relatively longer pharynx (0.15 mm) and length/breadth ratio greater (2.41-2.58 times), hind region of pharynx membranous and posterior border of pharynx with lateral constriction are important diagnostic characters in the identification of *S. mervynae* (♀).

The results of the present study show that *S. theodori pashtunica* is not a uncommon species (158/2013,7.8%) having a very wide but discontinuous distribution in Pakistan. There are no published reports incriminating *S.theodori pashtunica,* which is thought to be thermophilic and a possible vector of reptilian leishmaniasis[15] and plays no part in transmitting *Leishmania* to man.

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