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**Taxonomic Morphology of *Sergentomyia (Sintonius) clydei* Sinton (1928)  
and *Sergentomyia (Sintonius) tiberiadis pakistanica* Artemiev and  
Safayanova (1974) (Diptera, Psychodidae) from Pakistan**

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**Abstract :** During entomological surveys conducted by the author in the whole of Balochistan province, *Sergentomyia (Sintonius) clydei* Sinton (1928) (N=75) and *Sergentomyia (Sintonius) tiberiadis pakistanica* Artemiev and Safayanova (1974) (N=25) were collected from fifteen and 3 localities respectively. These localities appear to be the new record of this species in the existing literature to date. *Sergentomyia tiberiadis pakistanica* is being reported first time from Balochistan Province. Morphology of taxonomic characters not reported and measured previously are also described. Measured and illustrated in the present paper. Key for the identification of Pakistani species is also constructed. Comparative analysis of Balochistan specimen with the published data of this species from other territories is also given. Differential diagnosis of this species with its closest allies is also discussed.

**Key words:** *Sergentomyia clydei*, *Sergentomyia tiberiadis pakistanica*, sandflies, taxonomic characters

**INTRODUCTION**

***Sergentomyia clydei*:** Captain D. Clydei, I.M.S. collected some insects from Waziristan (United India, now in Pakistan) and sent it to Brig. J.A. Sinton for their identification. Amongst these, a distinct species was found and described by Sinton<sup>[1]</sup> and he proposed to call the species *Phlebotomus clydei*. Sinton<sup>[2]</sup> pointed out buccal armature of *P. clydei* (♀) with about 10-15 teeth and pigmented area with pointed tail and poorly developed pharyngeal armature and sketched it. Sinton<sup>[2]</sup> described *P. clydei* by adding that it has a much shorter III antennal segment, the end of which did not reach the tip of the proboscis, the palpal formula was 1, 2, 3, 4, 5 and length of wing is more than 4 times its breadth. In 1933, Sinton<sup>[3]</sup> described *P. clydei* (♂) with row of about 30 small buccal teeth arranged in groups, ascoid formula 1/3-15, palpal formula 1, 2, 4, 3, 5 and intermediate appendages (=Paramere) much shorter than inferior clasper (lateral lobe). Lewis<sup>[4]</sup> described *S. clydei* from Karachi, Lahore, Mir Muhammad, Rawalpindi and Taxilla, but measurements of hypopharynx, maxilla, mandible, cibarium, pharynx, spermatheca, coxite, style, paramere, aedeagus and surstyle were not supplied, nor wings, antennal segments, palps and ♂ terminalia were figured. Rab *et al.*<sup>[5]</sup> reported it from Uthal Balochistan, but neither measurements, nor account, nor drawings of diagnostic characters were supplied.

***Sergentomyia tiberiadis* Pakistani:** Adler and Theodor<sup>[6]</sup> collected flies from Tiberias, Palestine, which resembled *P. clydei* very closely but the number and shape of cibarial teeth of ♂ seemed to be different. The other difference was that they observed no armature in the pharynx whereas Sinton<sup>[1]</sup> figured toothed ridges in *P. clydei*. However, Adler and Theodor<sup>[6]</sup> named it as *Phlebotomus* sp. near *clydei* Sinton. However, Adler *et al.*<sup>[7]</sup> while comparing this species with specimens of *P. clydei* from India, pointed out the distinct comparison in between these two species. They, however, suggested that the *Phlebotomus* sp. near *clydei* should therefore, to be considered as a new species under the name of *Phlebotomus tiberiadis* sp. n. Thereafter, it was also recorded from southern Arabia (Yemen) by Theodor<sup>[8]</sup> and by Parrot<sup>[9]</sup> from Sudan. Theodor<sup>[10]</sup> also collected it from Jalalabad area of Afghanistan. Mesghali<sup>[11]</sup> mentioned its occurrence in Firuzabad near Kazerun in the Persian Gulf area. Lewis<sup>[4]</sup> collected it from N.W.F.P Pakistan. Artemiev and Safayanova<sup>[12]</sup> raised the Eastern form of Ethiopian and Israel, nominal to sub species level after considering its morphology as the sub species have 10-17 cibarial teeth (instead of 17-18 of *S. tiberiadis*) and spermatheca with 9-12 segments narrowing toward the tip. They designated this sub species as *Sergentomyia tiberiadis pakistanica*. However, they did not furnish the drawings of wing (of ♂ and ♀) and mandible (of ♀), antennae and palps (of ♂ and ♀) and genital atrium and

furca of ♀ flies of this sub species. Lewis<sup>[4]</sup> also did not supply the illustrations of the wing, antennae, palp of ♂ and ♀ flies, ♂ terminalia, ♀ genital atrium, furca and ♀ mandible of *S. tiberiadis* collected from N.W.F.P.

To fill this gap of knowledge, an extensive taxonomic study was carried out by the author in the whole of the Balochistan Province during 1996-2001 and collected 2013 sandflies comprising of genera *Phlebotomus*, *Sergentomyia* and *Grassomyia*<sup>[13]</sup>. In view of the insufficient descriptions of Adler *et al.*, Artemiev and Safayanova, Lewis, Mesghali, Rab *et al.*, Sinton, Theodor (*loc. cit.*), *Sergentomyia clydei* and *Sergentomyia tiberiadis pakistanica* are redescribed in the present paper. Taxonomic morphology not described by earlier workers are described in detail, 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.*<sup>[14]</sup>, Killick-Kendrick<sup>[15]</sup>, Killick Kendrick *et al.*<sup>[16]</sup>, Lawyer *et al.*<sup>[17]</sup> and Lewis<sup>[18]</sup> were followed. For the species identification of sandflies, keys furnished by Adler *et al.*<sup>[7]</sup>, Artemiev<sup>[19]</sup>, Artemiev and Safayanova<sup>[12]</sup>, Lewis<sup>[4,20]</sup>, Sinton<sup>[1,2,3]</sup> were consulted. Measurements are in millimeter (mm) otherwise as indicated. 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.

## RESULTS

***Sergentomyia (Sintonius) clydei* Sinton<sup>[1]</sup>:** *Phlebotomus clydei* Sinton<sup>[1]</sup> Indian J. Med. Res., 16:179<sup>[21]</sup>, Indian J. Med. Res., 16:312<sup>[2]</sup>, Indian J. Med. Res., 20:60, 72<sup>[22]</sup>, Indian J. Med. Res., 20:571<sup>[23]</sup>, Indian J. Med. Res. 20: 579<sup>[3]</sup>, Indian J. Med. Res., 21:420, *Phlebotomus (Paraphlebotomus) clydei* Sinton<sup>[1]</sup>, Parrot<sup>[24]</sup> Archs. Inst. Pasteur, Alger., 18:312. *Sergentomyia (Sintonius) clydei* Sinton<sup>[1]</sup>, Theodor<sup>[10]</sup>, Fliegen Palaearkt. Reg., 9c:51, Theodor and Mesghali<sup>[25]</sup> J. Med. Ent., 1:297, Lewis<sup>[4]</sup> Bull. Brit. Mus. Nat. Hist. (Ent.), 19: 42, Perfiliev<sup>[26]</sup>: 347, Artemiev<sup>[27]</sup> Medskaya Parazit., 45:37, Lewis<sup>[20]</sup> Bull. Brit. Mus. Nat. Hist. (Ent.), 37:308, Artemiev<sup>[9]</sup>: 29.

**Female:** Thirty eight specimens were examined (Fig. 1). Head, 0.36 (0.35-0.37) mm long, 0.31 (0.30-0.32) mm broad,

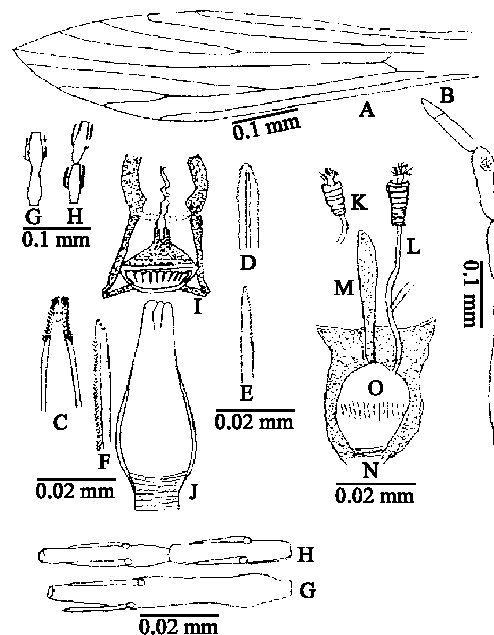


Fig. 1: Camera Lucida drawings of *Sergentomyia (Sintonius) clydei* (♀) from Balochistan showing: wing (A), palp (B), labrum (C), hypopharynx (D), mandible (E), maxilla (F), the third (G), fourth (H, lower), fifth (H, upper) antennal segments, cibarium (I), pharynx (J), spermatheca (K), spermathecal ducts (L), genital furca (M), genital atrium (N), genital armature (O)

Eye 0.168 (0.16-0.176) mm long, 0.484x length of head, 0.112 (0.104 -0.12) mm broad, distance between eyes 0.15 (0.14-0.16 mm). Wing (Fig. 1A) 1.50 (1.48-1.52) mm long, 0.386 (0.36-0.40) mm broad,  $\alpha=0.22$  (0.20-0.24) mm,  $\beta=0.32$  (0.28-0.36) mm,  $\delta=0.068$  (0.04-0.096) mm,  $\gamma=0.29$  (0.264- 0.336),  $\pi=+0.080$  (+0.064 to+0.096) mm, alar index=0.666-0.714. Palp (Fig. 1B) 0.664 mm long, with relative length 1:3:4.8:3.8:9.46, palpal formula 1, 2, 4, 3, 5, Newstead's sensillae situated on the basal third of segment 3 and number about 25 to 30. Proboscis 0.22 (0.21-0.23) mm long. Labrum (Fig. 1C) 0.20 (0.19-0.21) mm long, 0.133x length of wing and 0.555x length of head, labrum with 4 apical sensilla, each leaf like process, about 12 narrow adorals sensilla on each side and a sensilla depth 0.03 mm. Hypopharynx (Fig. 1D) apical margin of hypopharynx with deep indentations, forming broad tooth like structure, lateral margins undulating and a dental depth of 0.032 mm. Mandible (Fig. 1E) less broad (0.007 mm) with about 22 teeth and a dental depth of 0.028 mm. Maxilla (Fig. 1F) with three lateral teeth and about 30 ventrals, dental depth of 0.088 mm. A3 (Fig. 1G) 0.14 (0.13-0.15) mm long, 0.093x length of wing, 0.636x length of proboscis, 0.7x length of labrum, 0.903x combined length

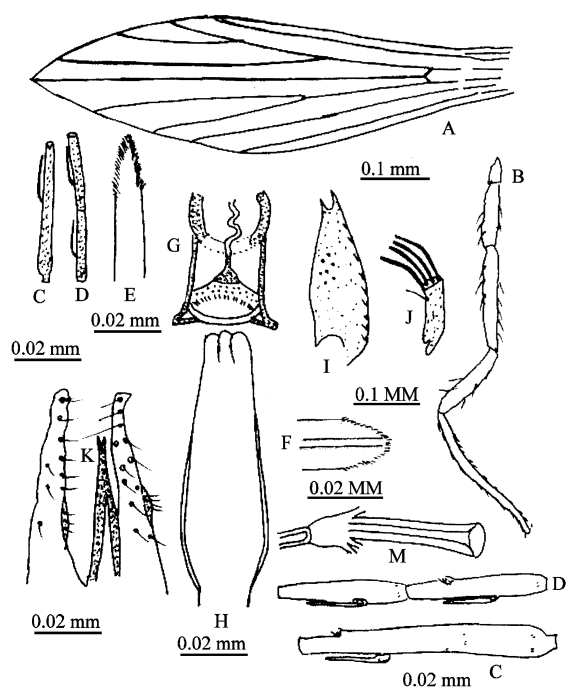


Fig. 2: Camera Lucida drawings of *Sergentomyia (Sintonius) clydei* (♂) from Balochistan showing: wing (A), palp (B), the third (C), fourth (D, lower), the fifth (D, upper) antennal segments, labrum (E), hypopharynx (F), cibarium (G), pharynx (H), coxite (I), style (J), paramere (K), aedeagus (L), genital pump (M), filament (N)

of A4+5, ascoid on A3 0.040 (0.036-0.044) mm long, ascoid 3/A3=0.285. A4 (Fig. 1H, lower) 0.077 (0.074-0.080) mm long, ascoid on A4= 0.041 (0.038-0.044) mm long, ascoid 4/A4=0.532. A5 (Fig. 1H, upper) 0.078 (0.076-0.080) mm long, ascoid on A5=0.042 (0.039-0.044) mm long, ascoid 5/A5=0.538. A3 was shorter than A4+5. The positions of the ascoids on segments are=AIH, 0.80, AIV, 0.347 and AV, 0.352. There are two ascoids on segments III to XV. Cibarium (Fig. 1I) 0.051 (0.048-0.055) mm broad with about 11-15 needle like pointed teeth (0.008 mm long) standing on a line almost straight, above these teeth a zigzag line of about 12-14 minute punctiform denticles, a well marked triangular pigment patch about 0.032 mm long and 0.011 mm broad with anterior broad bifid projection which becomes narrower anteriorly, chitinous arch developed at lateral sides but ill developed at the center. Pharynx (Fig. 1J) 0.158 (0.156-0.160) mm long, fore width 0.019 (0.018-0.020) mm, 0.053 (0.044-0.060) hind width, basal width 0.035 (0.034-0.036) mm. The length of pharynx about 2.66-3.545 times its breadth. The pharynx is 2.78 times as wide posteriorly as anteriorly. Height of armature 0.023 (0.02-0.025), 0.145x length of pharynx. The

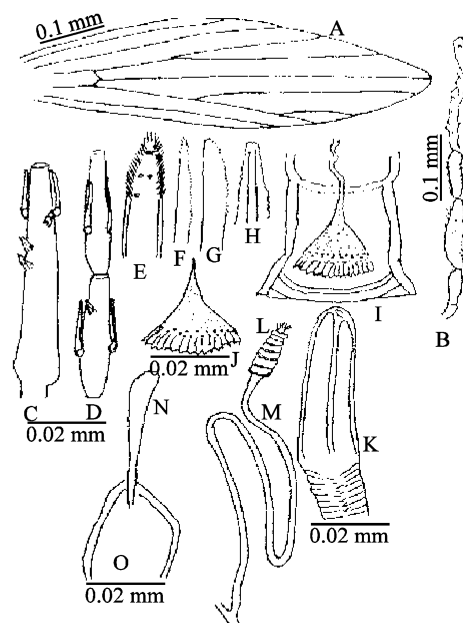


Fig. 3: Camera Lucida drawing of *Sergentomyia (Sintonius) tiberiadis pakistanica* (♀) from Balochistan showing: wing (A), palp (B), the third (C), the fourth (D, lower) and fifth (D, upper) antennal segments, labrum (E), hypopharynx (F) maxilla (G), mandible (H), cibarium (I) triangular pigment patch (J), pharynx (K), spermatheca (L), ducts (M), genital furca (N), genital atrium (O)

pharyngeal armature occupies most of the basal part of the pharynx. The anterior edge forms an almost straight line. The pharyngeal armature consists of a series of parallel transverse ridges. The posterior part of the armature is in long needle like punctiform ridges with short spines, whereas the anterior part is composed of unarmed transverse ridges. Spermatheca (Fig. 1K) with 8 to 10 segments, the apical segment has a very short neck (0.004 mm long) with hair like ductules about 0.005 mm long, gradually narrowing towards the base. Spermathecal capsule 0.022 (0.020-0.024) mm long, 0.009 (0.008-0.01) mm fore width, 0.015 (0.014-0.016) mm hind width, ducts (Fig. 1L) 0.011 (0.009-0.013) mm long, genital furca (Fig. 1M) about 0.06-0.065 mm long, ducts with a common opening into genital atrium (Fig. 1N) 0.053 (0.050-0.064) mm broad. The armature of the genital atrium lies between the side arms of the furca. A band of armature 0.004 mm long and 0.001 mm broad lies in between the furca (Fig. 1O). The spines of the armature point towards the opening of the atrium. The spines are closely arranged in three rows.

**Male:** Twenty six specimens were examined (Fig. 2). Head 0.362 (0.352-0.376) mm long, 0.322 (0.312-0.336) mm broad,

eye 0.168 (0.16-0.176) mm long, 0.464x length of head, 0.087 (0.086-0.088) mm broad and distance between eyes 0.165 (0.15-0.17) mm. Wing (Fig. 2A) 1.37 (1.28-1.52) mm long, 0.36 (0.32-0.40) mm broad,  $\alpha=0.18$  (0.15-0.22) mm,  $\beta=0.27$  (0.24-0.30) mm,  $\delta=0.068$  (0.04-0.096) mm, in two specimens from Turbat and in one specimen from Bela,  $\delta$  is observed to be zero,  $\gamma=0.265$  (0.24-0.29) mm long,  $\pi=0.068$  (0.04-0.08) mm, in one specimen from Kahan  $\pi$  is observed to be zero, alar index=0.625-0.733. Palp (Fig. 2B) 0.526 (0.51-0.54) mm long, with relative length 1:3.25:5.46:4.8:1.6 and formula 1,2,4,3,5, Newstead's sensillae situated at the basal third of segment 3 and number about 20-25. Proboscis 0.195 (0.18-0.21) mm long. A3 (Fig. 2C) 0.16 (0.15-0.17) mm long, 0.116x length of wing, 0.969x length of labrum, 0.941x combined length of A4+5, ascoid on A3=0.027 (0.022-0.032) mm long, ascoid 3/A3=0.168. A4 (Fig. 2D, lower), 0.082 (0.078-0.090) mm long, ascoid on A4=0.030 (0.028-0.031) mm long, ascoid 4/A4=0.365. A5 (Fig. 2D, upper) 0.088 (0.08-0.094) mm long, ascoid on A5=0.031 (0.030-0.032) mm long, ascoid 5/A5=0.352. Ascoid formula 1/3-15. Antennal segments III and IV have a single prominent papilla (Fig. 2C-2D). On A3, it is usually at the opposite side of the ascoid but is occasionally anterior or posterior to it. On AIV the papilla was anterior to ascoid tip. The positions of the papillae on segments are=AIII, 0.847 and AIV, 0.67. Labrum (Fig. 2E) 0.165 (0.16-0.17) mm long and a dental depth of 0.036 mm. Hypopharynx (Fig. 2F) 0.018 mm broad, apex broad and a dental depth of 0.024 mm. Cibarium (Fig. 2G) 0.047 (0.04-0.055) mm broad, with about 16-22 small teeth arranged in groups of 2-3 on a line slightly convex posteriorly and above the teeth an irregular row of punctiform denticles, above the denticles is a pigment patch of about 0.02 mm long and 0.008 mm broad which is less developed in male than the same structure in the female, pigmented area with a long anterior process, pigment patch about 0.425 width of cibarium, chitinous arch well developed at lateral flanges but ill developed at center. Pharynx (Fig. 2H) 0.15 (0.14-0.16) mm long, fore width 0.024 (0.022-0.03) mm, hind width 0.05 (0.044-0.056) mm, basal width 0.02-0.028 mm, height of armature 0.014 (0.012-0.016) mm and 0.093x length of pharynx. Pharyngeal armature weak and small and occupies most of the hind part behind the pharyngeal bulge. Pharynx is 2.08 times as wide posteriorly as anteriorly. Coxite (Fig. 2I) 0.215 (0.21-0.22) mm long, 0.061 (0.052-0.07) mm broad, coxite length/breadth=3.14-4.03, coxite/style=2.2-2.33, coxite/labrum=1.29-1.31, coxite/A3=1.29-1.4, Style (Fig. 2J) 0.095 (0.09-0.1) mm long, 0.024 (0.02-0.028) mm broad, style with 2 apical 2 sub apical spines, seta at 0.71 (0.666-0.777) of the style. Paramere (Fig. 2K) 0.16 (0.14-0.18) mm long, the basal and central part of the body of paramere less

extend downward about 0.02 mm, with a ventral tubercle 0.02-0.024 mm long and 0.007-0.008 broad bearing 3-4 short spinules, body of paramere bears about 10 long bristles gradually narrowing towards anterior and finally bends laterally like a bird's head. Aedeagus (Fig. 2L) 0.105 (0.10-0.11) mm long, less pigmented and has a sharply pointed ends. Genital pumps (Fig. 2M) 0.118 (0.106-0.13) mm long, filament (Fig. 2N) 0.47 (0.40-0.54) mm long, F/P=3.98 (3.77-4.154) mm. Surstyle 0.205 (0.19-0.22) mm long and 0.953x length of coxite.

**Distribution :** Balochistan. New Record, Present survey: Bela, Dashte Kuddan, Dera Bugti, Dhadar, Kahan, Khuzdar, Kohlu, Mand, Mewand, Nal, Panjgour, Parom, Sibi, Tump, Turbat. These localities are important foci of cutaneous leishmaniasis. Flies were caught using mouth aspirators and sticky traps from indoors and out doors. Uthal<sup>[28]</sup>.

**Sergentomyia (Sintonius) tiberiadis pakistanica** Artemiev and Safyanova<sup>[12]</sup>

*Phlebotomus* sp. near *clydei*, Adler and Theodor<sup>[6]</sup> Ann. Trop. Med. Parasit., 23: 284. *Phlebotomus tiberiadis*, Adler *et al.*<sup>[7]</sup> Bull. ent. Res., 21: 537. *Sergentomyia (Sintonius) tiberiadis* Adler *et al.*<sup>[7]</sup>, Theodor and Mesghali<sup>[25]</sup>, J. Med. Ent., 1: 297 (Afghanistan), Lewis<sup>[4]</sup> Bull. Brit. Mus. Nat. Hist. (Ent.), 19: 44. *Sergentomyia (Sintonius) tiberiadis pakistanica* Artemiev and Safyanova<sup>[12]</sup> Med. Parazit., 43: 543; Artemiev<sup>[27]</sup> Medskaya Parazit, 45: 38; 1978: 30; Lewis<sup>[20]</sup> Bull. Brit. Mus. Nat. Hist. (Ent.), 37: 311.

**Female:** Four specimens were examined (Fig. 3). Wing (Fig. 3A) 1.3 (1.20-1.38) mm long, 0.31 (0.304-0.32) mm broad.  $\alpha=0.12$ -0.14 mm,  $\beta=0.20$ -0.24 mm,  $\delta$ =zero,  $\gamma=0.24$ -0.28 mm,  $\pi$ =zero to 0.02 mm. Alar index=0.583-0.6. Palp (Fig. 3B) 0.50-0.512 mm long, palpal ratio 1 : 2.83 : 5.16 : 3.75 : 8.5 and palpal formula 1, 2, 4, 3, 5. Newstead's sensillae long and conspicuous and are situated on the basal third of segment III and number about 25-30. Proboscis 0.18-0.19 mm long. A3 (Fig. 3C) 0.112-0.116 mm long, ascoid on A3=0.034-0.036 mm long, ascoid 3/A3=0.30-0.31. A3 is 0.61-0.622x length of proboscis, 0.682-0.7x length of labrum, 0.84-0.868x length of A4+5. A4 (Fig. 3D, lower) 0.064-0.068 mm long, ascoid on A4=0.035-0.04 mm long, ascoid 4/A4=0.546-0.588. A5 (Fig. 3D, upper) 0.065-0.070 mm long, ascoid on A5=0.036-0.040 mm long, ascoid 5/A5=0.553-0.571. Antennal segments III has three prominent papillae (Fig. 3C), two are at the side of ascoid but posterior to ascoid whereas the third one is near the base of ascoid of opposite side. On A4 a single papilla is near the tip of the ascoid. The positions of the papillae on the segments are: AIII, 0.48, 0.55, 0.82, AIV, 0.62, 0.70. The

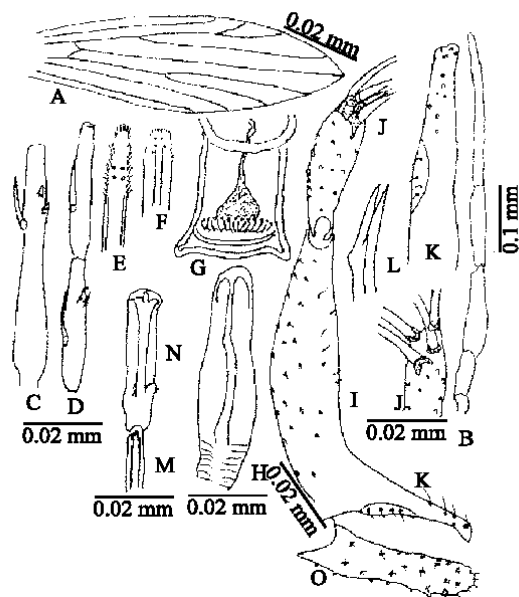


Fig. 4: Camera Lucida drawing of *Sargentomyia (Sintonius) tiberiadis pakistanica* (♂) from Balochistan showing: wing (A), palp (B), the third (C), the fourth (D, lower) and fifth (D, upper) antennal segments, labrum (E), hypopharynx (F) cibarium (G), pharynx (H), coxite (I), style (J), paramere (K), aedeagus (L), genital filament (M), pump (N), surstyle (O)

positions of the ascoids on the segments are: A3, 0.68, A4, 0.35, A5, 0.38. There are two ascoids on segments III to XV. Labrum (Fig. 3E) 0.16-0.17 mm long, 0.12-0.13x length of wing, with 4 apical sensillae, sensillae depth 0.028 mm. Hypopharynx (Fig. 3F) with lateral margins weakly undulating and apical margin appears smooth. Maxilla (Fig. 3G) with 6 lateral teeth, 27 ventrals and a dental depth of 0.098 mm. Mandible (Fig. 3H) narrow, with five median sized re-curved teeth per 0.004 mm. Cibarium (Fig. 3I) 0.048-0.055 mm broad with 12-16 teeth, wide and pointing upward, arranged on an arc anteriorly convex and anterior to these teeth are about 10-15 minute punctiform denticles arranged in 1-2 zigzag row, chitinous arch faint, a triangular pigment patch (Fig. 3J) 0.032 mm long and 0.02 mm height nearly as broad as cibarial armature stretching anteriorly into a long anterior process. Pharynx (Fig. 3K) narrow, 0.12 (0.112-0.13) mm long, 0.022-0.024 mm anterior breadth, 0.028-0.030 mm posterior breadth. Pharynx is 1.25-1.27 times as wide posteriorly as anteriorly, pharynx narrowing gradually behind the bulge and basal width 0.024 mm, pharyngeal armature consisting of weak transverse ridges at the both sides of the posterior to the pharyngeal bulge. Spermatheca (Fig. 3L) 0.028 mm long, 0.009 mm anterior breadth, 0.012 mm

maximum breadth, with 7-9 segments, narrowing towards apex, spermathecal ducts (Fig. 3M) narrow and about 0.16 mm long ending into a short common duct, furca (Fig. 3N) 0.088 mm long and genital atrium (Fig. 3O) 0.04 mm broad.

**Male:** Twelve specimens were examined (Fig. 4). Wing (Fig. 4A) 0.15 (0.12-0.20) mm long, 0.26 (0.256-0.272) mm broad,  $\alpha=0.114$  (0.104-0.124) mm,  $\beta=0.25$  (0.24-0.26) mm, long  $\delta=$  zero in two specimen, in 10 specimen  $\delta=+0.024$  mm,  $\gamma=0.232$  (0.224-0.24) mm,  $\pi=0.088$  (0.08-0.096) mm. Alar index=0.456. Palp (Fig. 4B) 0.53 mm long, palpal ratio 1:2.33: 4.33: 3.66: 6.33, with palpal formula 1, 2, 4, 3, 5. Proboscis= 0.17 (0.16-0.18) mm long. A3 (Fig. 4C) 0.13 (0.12-0.15) mm long, 0.984x length of labrum, 0.764 x length of proboscis, 0.787 x length of A4 + 5, ascoid on A3 = 0.028-0.030 mm long and ascoid 3/A3=0.215-0.23. A4 (Fig. 4D, lower) 0.08 (0.076-0.088) mm long, ascoid on A4=0.028-0.032 mm long, ascoid 4/A4=0.363-0.368. A5 (Fig. 4D, upper) 0.085 (0.076-0.09) mm long, ascoid of A5=0.028-0.03 mm long, ascoid 5/A5=0.333-0.368. Antennal segments III have two prominent papillae and IV have a single prominent papilla (Fig. 4C-4D). On AIII and AIV it is usually at opposite side of the ascoid. On AIII, they are occasionally at about the mid length of the ascoid whereas on AIV, it is at about the tip of the ascoid. The positions of the papillae on segments are: AIII, 0.85, AIV, 0.736. AIII is shorter than AIV+A5. The positions of the ascoids on the segments are: AIII, 0.646, AIV, 0.333 and AV, 0.343. There is a single ascoid on segments III to XV. Labrum (Fig. 4E), 0.132 (0.12-0.14) mm long, 0.114x length of the wing, with 5-6 small apical sensilla and a sensilla depth of 0.04 mm long. Hypopharynx (Fig. 4F) with 8-9 sharply pointed teeth like structures at apex whereas about 11 teeth at each side, apical margin 0.009 mm broad and a dental depth of 0.028 mm. Cibarium (Fig. 4G) 0.044-0.048 mm broad, 13-15 long and pointed teeth standing on an almost straight line of 0.04 mm long, about 15 minute punctiform denticles arranged in a zigzag line anterior to the long teeth, pigment patch triangular, less broad, 0.026 mm broad, 0.018 mm height, with a short anterior process, chitinous arch developed. Pharynx (Fig. 4H) 0.136 (0.12-0.14) mm long, 0.03 (0.024-0.04) mm anterior breadth, 0.05 (0.035-0.07) mm posterior breadth, 0.03-0.044 mm basal breadth. Pharynx is 1.66 times as wide posteriorly as anteriorly, pharyngeal armature about 0.02 mm long, 0.147x length of pharynx, armature consisting of weak transverse ridges at the basal part of the pharynx. Coxite (Fig. 4I) 0.18 (0.16-0.20) mm long, 0.052 (0.046-0.064) mm broad, coxite length/breadth=3.46, coxite/style=2.285-2.30, coxite/labrum=1.36 (1.33-1.42), coxite/A3=1.33 Style (Fig. 4J) 0.07-0.084 mm long, 0.025-0.028 mm broad, style length/breadth= 2.8-3.0, with 2 apical spines and 2 sub

Table 1: Comparison of taxonomic characters (mm) of *Sergentomyia (Sintonius) clydei* Sinton from Balochistan and the published data of this species from other territories

♀ Taxonomic characters	Balochistan	Waziristan Pakistan <sup>[1]</sup>	Rawalpindi, Pakistan <sup>[4]</sup>	Southern India <sup>[20]</sup>
Head	0.347 (0.344-0.35) long	0.435 long	-	-
Wing Length	1.51 (1.48-1.52)	1.736	1.75 (1.60-1.93) long	1.71 long
Breadth	0.386 (0.36-0.40)	0.423	0.43 (0.39-0.480) broad	
$\alpha$	0.216 (0.20-0.24)	0.225		
$\beta$	0.326 (0.28-0.36)	0.317		
$\delta$	0.068 (0.04-0.096)	0.062		
$\gamma$	0.29 (0.264-0.336)	0.315		
Alar index	0.674 (0.666-0.714)	0.61-0.80		0.7
Palps	0.664 long	0.705 long	-	-
Relative Length	1:3.22:4.77:3.77:7.77			
Palpal Formula	1,2,4,3,5			
A3 Length	0.14 (0.13-0.15)	0.141	0.15 (0.14-0.17)	0.14
A3/Wing	0.093			
A3/Labrum	0.7		0.7	0.67
A3/A4+5	0.903	A3<A4+5	0.9 (0.9-1.0)	0.89
Ascoïd formula	2/3-15	2/3-15		2/3-15
Ascoïd 4/A4	0.54		0.6	0.49
Labrum Length	0.20 (0.19-0.215)	0.219	0.22 (0.20-0.25) long	0.22 mm long
Maxilla	With 3 lateral teeth and about 30 ventrals, dental depth 0.088	-	-	With 3 lateral teeth and 35 ventral teeth, dental depth 0.108.
Cibarium	9-11 needle like cibarial teeth, triangular pigmented area and bifid anteriorly with anterior process, chitinous arch faint in the center	15 large sharply pointed cibarial teeth, triangular pigmented area	Chitinous arch faint in center	12 horizontal cibarial teeth, pigment patch well developed.
Pharynx	0.158 (0.156-0.160) long 0.053 (0.044-0.060) broad, the length of pharynx about 2.66-3.545 times its breadth. The pharynx is 2.78 times as wide posteriorly as anteriorly.	0.174 long 0.06 broad, the length of the pharynx is about 2.75-2.90 times its breadth.	-	-
Spermatheca	8-10 segmented, segments decrease in size towards duct, spermathecal duct open into a common duct.	-	About 9 segments, spermathecal ducts open into a common duct.	About 9 equal segments

Table 1 (continued)

♀ Taxonomic characters	Afghanistan <sup>[19]</sup>	Africa (Sudan and Ethiopia) <sup>[20]</sup>	Kazakhstan and Turkmenia <sup>[20]</sup>
Wing Length	-	1.58-1.88	1.70- 1.88
Breadth	-	0.45-0.46	0.40-0.55
$\delta$	-	+ 0.035 to 0.085	-
Alar index	-	0.61-0.97	-
Palpal Formula	-	1,2,4,3,5	-
A3 Length	-	0.138-0.165	0.14-0.16
A3/labrum	0.6-0.72	0.62-0.75	-
A3/A4+5	-	A3<A4+5	A3<A4+5
Ascoïd formula	-	2/3-15	1,2,4,3,5
Ascoïd 4/A4	-	0.5	-
Labrum Length	-	0.214-0.228	Slightly more than half as long as segment 0.21-0.24
Cibarium	Cibarium with 11-15 separate pointed teeth, pigmented patch bifid anteriorly, with anterior process.	12-16 strong pointed teeth	12-15 large uniform teeth in a straight or slightly curved row. Buccal teeth narrow, triangular with long points, slightly separated from each other. Fine punctiform denticles in one or two rows anterior to buccal teeth on background of pigmented area, pigmented area large, brownish more or less triangular with light pointed anterior process. Pharynx large lamp glass shaped. Armature much reduced and consisting of thin irregular lines. Consisting of 8-10 segments, apical segments larger than the others, size of segments decreasing towards base. Head without neck. Ducts transversely striated, spermatheca resemble those of <i>P. papatasi</i> .
Pharynx	-	Pharynx more than twice as wide posteriorly as anteriorly	
Spermatheca	8-10 segments, narrowing towards the base.	8-10 segments, narrower towards the duct.	

Table 1 (continued)

♀ Taxonomic characters	Afghanistan <sup>[19]</sup>	Africa (Sudan and Ethiopia) <sup>[20]</sup>	Kazakistan and Turkmenia <sup>[26]</sup>
Wing length		1.54-1.82	1.5-1.8
Breadth		0.36-0.44	0.36-0.44
$\alpha$			
$\beta$	-		
$\delta$		+ 0.028 to 0.011	
$\gamma$			
Alar index		0.55-0.97	
Palpal Formula	-	1,2,4,3,5	1,2,4,3,5.
A3 Length	148-180 l	0.153-0.185	0.14-0.18
A3/Labrum	0.8-1.0	0.83-0.85	
A3/A4+5		A3<A4+5	A3<A4+5
Ascoid formula	-	1/3-15	
Ascoid 4/ A4		0.4	Almost half as long as segment
Labrum Length	-	-	0.18-0.22
Cibarium	With 16-26 small teeth in groups of 2-4.	Small cibarial teeth in groups of 4-6 on an arc slightly concave posteriorly	20-22 short, thin teeth in groups of 2-4 which stands some distance from each other on an almost or slightly curved line. a row of very small punctiform denticles anterior to buccal teeth, pigmented area small with narrow anterior process.
Pharynx	-	Pharynx about 2.5 times as wide posteriorly as anteriorly.	Narrow, armature practically absent, consisting of a few thin lines.
Coxite Length	228-271	0.213-0.271	0.22-0.29
Style Length	104-120	0.10-0.12	0.10-0.12
Seta at		0.7	
Paramere	With narrow hooked end	0.168-0.225 long, hooked.	With narrow hooked end
Aedeagus		0.45-0.072 long	
Surstyle		0.270, shorter than coxite.	0.24-0.26 long, almost as long as coxite.
Filament/Pump	4.0-5.0	-	-

Table 2: Comparative taxonomic characters (mm) of *Sergentomyia (Sintonius) tiberiadis pakistanica* Artemiev and Safyanova, 1974, from Balochistan and the published data of this species and of *S. tiberiadis* from other territories

♀ Taxonomic characters	Balochistan (Present study)	<i>S. s. tiberiadis</i> , Adler, Theodor and Lourie. <sup>[14]</sup> , (only 4 ♀♀)	<i>Phlebotomus</i> sp. near <i>clydei</i> Sinton <sup>[6]</sup> and <i>Phlebotomus tiberiadis</i> <sup>[7]</sup> from Palestine
Wing Length	1.3 (1.20-1.38)	1.50 ( 1.36-1.61)	
Breadth	0.31 ( 0.304 0.32)	0.32 ( 0.30-0.33)	
Alar index	0.583-0.6	0.5 (0.1-0.7)	0.5-0.7
$\delta$	zero	- 0.7 (-2.0 to 1.0)	usually zero
A3 Length	0.112-0.116	0.17 (0.16-0.18)	
A3/A4+5	0.84-0.868 (=A3<A4+5)	0.9	A3<A4+5
A3/labrum	0.682-0.7	0.9 ( 0.8-0.9)	
Labrum Length	0.16-0.17	0.19 (0.17-0.20)	-
Ascoid 4 / A4	0.546-0.588	0.4	-
Palp Formula	1, 2, 4, 3, 5.	1, 2, 4, 3, 5.	1, 2, 4, 3, 5
Cibarium	12-16 teeth, pointing upward standing on a line anteriorly convex arc and anterior to these teeth are about 10-15 minute punctiform denticles, chitinous arch faint, broad pigment patch with a long anterior process.	12 teeth, points directed upward, 1-2 rows of large denticles present, chitinous arch indistinct, postero lateral corners of cibarium prominent, pigment patch as broad as armature, with long forward extension.	Pigmented area heart shaped, very faint, 16-17 teeth standing on a line slightly convex anteriorly. The teeth are pointed and directed towards the middle of the buccal cavity, behind them there is a row of small indentations.
Pharynx	1.25-1.27 times as wide posteriorly as anteriorly, armature consisting of weak transverse ridges.	Pharynx narrowing gradually behind bulge, almost smooth posteriorly.	Pharynx appears to be entirely unarmed. Posteriorly it is less than twice as wide as anteriorly.
Spermatheca	7-9 segments, narrowing towards apex, ducts narrow, ending into a short common duct.	Spermatheca small, narrowing towards apex with about 9 faintly and discernibly segments, ducts long and narrow leading to a short common duct.	6-8 segments and very similar to those of <i>P. papatasi</i> , but smaller with narrow ducts.

Table 2: (Continued)

♂ Taxonomic characters	Balochistan (Present study)	<i>Phlebotomus</i> sp. near <i>clydei</i> Sinton <sup>[6]</sup> and <i>Phlebotomus tiberiadis</i> <sup>[7]</sup> from Palestine
Cibarium	13-15 long and pointed teeth standing on an almost straight line	A row of 12-13 pointed teeth similar in general arrangement to those of female
Pharynx	Pharynx posterior breadth is 0.05 (0.035-0.07)	Pharynx narrower than in the females
Paramere	Not rounded at apical end, in some preparations it appears like a bird's head	Paramere ends in a sharply pointed beak like process
Aedeagus	With pointed ends without a sub apical tubercle	Intromittant organ ends in a very sharp point



apical spines at 0.83 of the style, tips of the spines usually spatulate, seta about 0.028 mm long and at 0.71 of the style. Paramere (Fig. 4K) 0.085-0.09 mm long, blunt, broad but not rounded at apical end, in some preparations the tip of the paramere appeared like a bird's head, ventral tubercle 0.028 mm long, 0.007 mm broad, with 4-5 bristles at 0.35-0.4x length of the paramere, the basal part of the body of paramere 0.040-0.045 mm long, 0.03-0.04 mm broad, gradually narrowing from ventral tubercle up to a blunt ending with many bristles about 0.045-0.048 mm long and 0.013-0.018 mm broad. Aedeagus (Fig. 4L) 0.075-0.085 mm long, slender, 0.004 mm broad, with pointed ends and without sub-apical tubercle. Genital filament (Fig. 4M) 0.40 (0.30-0.54) mm long and pump (Fig. 4N) 0.10 (0.09-0.11) mm long, with filament/pump ratio of 4.0 (3.33-4.9). Surstyle (Fig. 4O) 0.13 (0.12-0.14) mm long, about 0.70-0.75x length of coxite.

**Distribution:** Balochistan. Present survey: New record: Bela, Khuzdar, Turbat. These localities are important foci of cutaneous leishmaniasis. Sandflies were collected from residential houses through sticky traps.

**Key for the identification of Pakistani *S. clydei* and *S. tiberiadis pakistanica*:**

Cibarial teeth in a transverse row, foreteeth some times present and usually pointing upward. Pigment patch usually present. Hind ends of abdominal tergites 2-6 usually with all or most hairs recumbent, most sockets much smaller than on 1. Style with four spines and an accessory seta..... Genus *Sergentomyia*

Spermatheca distinctly segmented and usually small, clydei series with 18 or fewer cibarial teeth and hospitii series, with 35 or more teeth and a narrow tip of the hypopharynx, abdominal tergites 2-6 with a few posterior erect hairs but very few in male *S. clydei* or normally tergite 6 bears no hairs ..... Subgenus *Sintonius*

Cibarium with 11-15 needle like pointed teeth standing on a line almost straight, above these teeth a zigzag line of about 12-14 minute punctiform denticles, a well marked triangular pigment patch, A3=0.13-0.15 mm long, spermatheca with eight to 10 segments, apical segment with a short neck..... ♀ *S. clydei*

12-16 cibarial teeth wide and pointing upward arranged on an arc anteriorly convex and anterior to these teeth are about 10-15 minute punctiform denticles arranged in one or 2 zigzag row, A3=0.11 mm long, spermatheca with 7-9 segments narrowing towards apex ..... ♀ *S. tiberiadis pakistanica*

Cibarium with 16-22 small teeth arranged in groups of 2-3 on a line slightly convex posteriorly and above these teeth an irregular row punctiform denticles, pigmented

area less developed (in male than females) with long anterior process, A3=0.15-0.17 mm long, style with two apical and 2 sub apical spines ..... ♂ *S. clydei*

13-15 long cibarial teeth standing on an almost straight line and about 15 minute punctiform denticles arranged in a zigzag line anterior to the long teeth, pigment patch triangular with a short anterior process, A3=0.12-0.15 mm long, tips of the spines usually spatulate..... ♂ *S. tiberiadis pakistanica*

## DISCUSSION

The morphology and measurements of various characters of *S. clydei* show considerable differences when compared with the published data of this species from other territories (Table 1). ♀ *S. clydei* from Balochistan are observed having a relatively shorter head as compared with published data of this species from Waziristan<sup>[1]</sup>, a little shorter wing as compared with the form from Waziristan, Rawalpindi<sup>[4]</sup>, Afghanistan<sup>[19]</sup>, Southern India<sup>[28]</sup> and Africa<sup>[29]</sup> and a little shorter labrum as compared with published data from Waziristan<sup>[1]</sup>, Rawalpindi<sup>[4]</sup>, Southern India<sup>[28]</sup> and Africa<sup>[29]</sup>. Taxonomic character like antennal segment 3 from Balochistan are found of the same length as reported from Waziristan<sup>[1]</sup> and Rawalpindi<sup>[4]</sup> but a little shorter as compared with the published data of this species from Afghanistan<sup>[19]</sup> and Southern India<sup>[28]</sup>. However, Balochistan forms are observed corresponding well in diagnostic characters like ascoid formula, palpal formula, seta at style and A3<A4+5 with the published data of these characters of this flies from Waziristan<sup>[1]</sup>, Rawalpindi<sup>[4]</sup> and Africa<sup>[29]</sup>. Further, A3/labrum is measured similar as that reported from Southern India<sup>[28]</sup> and Africa<sup>[29]</sup> but is slightly shorter as that from Rawalpindi<sup>[4]</sup> and Afghanistan<sup>[19]</sup>. Number of cibarial teeth, figures of cibarium and pharynx of Balochistan forms are noted to be almost similar as that of reported from Waziristan<sup>[1]</sup>, Rawalpindi<sup>[4]</sup>, Afghanistan<sup>[19]</sup> and Southern India<sup>[28]</sup>. Likewise, characters like A3 A3<A4+5, ascoid formula, palpal formula, cibarial teeth and spermatheca of 8-10 segments of ♀ *S. clydei* of Balochistan form are found corresponding well with the published data of this species from Waziristan<sup>[1]</sup>, Rawalpindi<sup>[4]</sup>, Southern India<sup>[28]</sup> and Africa<sup>[29]</sup>.

♀ *S. clydei* from Balochistan is found resembling with the data of this species from Kazakhstan and Turkmenia<sup>[26]</sup> in characters like spermathecae (Balochistan form=8-10 segments, Kazakhstan and Turkmenia=8-10 segments) but found differing in characters like cibarial teeth (Balochistan specimens=9-11 needle like teeth, Kazakhstan and Turkmenia form=12-15 uniform teeth in a straight or at slightly curved row) and also in wing size (Balochistan

specimens=1.48-1.52 mm long, Kazakhstan and Turkmenia forms=1.72-1.88 mm long).

#### Differential diagnosis of *S. clydei* with its closest allies:

*S. clydei* may be differentiated on the bases of characters, in addition to others, like in female specimens cibarium with about 12-15 long equal teeth, pharynx with thick walls and an abrupt constriction behind the bulge, 1-4 papillae on A3 and one or 2 on A4. Male of this species can be identified, in addition to other characters, on the basis of cibarial teeth which are minute and arranged in group<sup>[20]</sup>. Other closest allies of this species are *S. hospitii* Sinton<sup>[30]</sup>: In addition to other taxonomic characters, its female has 50-60 cibarial teeth and pharynx with distinct spicules. Cibarium of male specimen has about 28 teeth. Both sexes have spines on femur 1<sup>[20]</sup>. *S. christophersi* Sinton<sup>[31]</sup>: Cibarium of the female with four or five separated teeth and very small pigment patch<sup>[20]</sup>. *S. tiberiadis* Adler *et al.*<sup>[7]</sup>: The female has 10-18 cibarial teeth in comb formation, the middle ones smaller than the laterals<sup>[20]</sup>. *S. edithae* Sinton<sup>[23]</sup>: The female has about 35 large pointed cibarial teeth in a row, spermathecae with 12 segmented and a small head whereas in male specimen 20 cibarial teeth<sup>[20]</sup>. *S. sirohi* Kaul *et al.*<sup>[32]</sup>: Female has 10-12 spaced pointed teeth and usually (unlike *tiberiadis*) no fore teeth<sup>[20]</sup>.

*S.t. pakistanica* Artemiev and Safayanova<sup>[12]</sup>: In female, cibarium with a comblike row of about 16-18 teeth and cibarial teeth on concave arc<sup>[20]</sup>. *S. orissa* Kaul and Lewis<sup>[33]</sup>: The female has 24-28 cibarial teeth and pharynx very heavily armed whereas cibarial teeth on an arc convex in center<sup>[20]</sup>.

The morphology and measurements of various taxonomic characters of *S.t. pakistanica* show considerable differences when compared with the published data of this species from other territories (Table 2). Balochistan form is found to differ from the north Pakistani<sup>[4]</sup> in characters like shorter wing, alar index, A3, A3/A4 + 5, A3/labrum and labrum, but it is observed having fully accord with Adler *et al.*<sup>[7]</sup> description in characters like alar index,  $\delta$ , A3 /A4+5, palp formula, morphology of cibarium and pharynx and structure of spermatheca. Female specimens from Balochistan are found differing with the published data of this species from Afghanistan<sup>[19]</sup> in characters like A3 (Balochistan form=0.112- 0.116 long, Afghanistan specimens=128-160  $\mu$ m), Cibarium (Balochistan=12-16 teeth wide pointed with 10-15 minute punctiform denticles, Afghanistan=10-17 teeth wide with pointed ends and 2-4 rows of verticles denticles) and spermatheca (Balochistan=7-9 segmented, Afghanistan=9-12 segmented).

The results of the present study show that *S. clydei* is an uncommon species (75/2013, 3.73%) but

discontinuously distributed. In the east its range extends into India, where according to Sinton<sup>[2]</sup> it has been recorded widely from the plains. There are no published reports incriminating *S. clydei*, which is thought to be thermophilic, xerophilous and a main vector of reptilian leishmaniasis<sup>[19]</sup> and presumably plays no part in transmitting *Leishmania* to man. The results of the present study also show that *S. t. pakistanica* is a very rare species (25/2013, 1.24%) and has a localized distribution in Balochistan. There are no published reports incriminating *S.t. pakistanica*, which is thought to be thermophilic, xerophilous<sup>[19]</sup> and presumably plays no part in transmitting *Leishmania* to man.

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