



Journal of Biological Sciences

ISSN 1727-3048

science
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**New Records of *Grassomyia dreyfussi turkestanica* Theodor and Mesghali (1964)
from Pakistan and *Grassomyia indica* Theodor (1931) (Diptera, Psychodidae)
from Some New Localities of Balochistan Province**

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Abstract: During entomological surveys conducted by the author in the whole of Balochistan Province, *Grassomyia dreyfussi turkestanica* Theodor and Mesghali (1964) (N=53) and *Grassomyia indica* Theodor (1931) (N=54) were collected from fourteen and twelve localities respectively. *Grassomyia dreyfussi turkestanica* Theodor and Mesghali (1964) is being reported first time from Pakistan and *Grassomyia indica* Theodor (1931) is recorded from some new localities of the Province. These localities appear to be the new records of these species in the existing literature to date. Morphology of taxonomic characters not reported and measured by earlier workers are also described, measured and illustrated. Key for the identification of these Pakistanese species is also constructed. Comparative analysis of Balochistan specimens with the published data of these species from other territories is also given.

Key words: *Grassomyia dreyfussi turkestanica*, *Grassomyia indica*, sandflies, taxonomic characters

INTRODUCTION

Grassomyia dreyfussi turkestanica was first described by Theodor and Mesghali^[1] from Turkistan and Iran shaher (Iramian Balochistan). Perfiliev^[2] recorded *S. squamipleuris karkalensis* from Turkmanistan and suggested that it was apparently identical with *S. dreyfussi turkestanica* Theodor and Mesghali^[1]. Later, this species was recorded by Artemiev^[3] from Afghanistan, but it was never recorded from Pakistan prior to the present survey. However, while describing *S. d. turkestanica* from Iran and Turkistan, Theodor and Mesghali^[1] and from Afghanistan, Artemiev^[3] did not describe nor sketch wing, palp, labrum, hypopharynx, maxilla, mandible, antennal segments, aedeagus, paramere, genital filament, pump, genital atrium and genital furca.

Grassomyia indica, Newstead^[4] described a new species (by 2 ♀♀, collected by King, on 7, 8, viii.1910 from Khartoum, Sudan), as *Phlebotomus squamipleuris*. Sinton^[5] reported and described both the sexes of this species from Kassauli (Punjab, United India), Piparya Railway station (Central Province, India) and Gundy (Madras, India). Sinton^[6] reported this fly from Lahore and Peshawar. Sinton^[7] described the cibarium of ♂ and ♀ of this species. Theodor^[8] pointed out certain differences between African and Indian forms of the species and

separated the later from the type as *P. squamipleuris* var. *indicus*, nov and he furnished diagrams of pharynx and spermatheca and noted that A3 was relatively shorter and buccal cavity was with 33 teeth. This species was also reported by Sobti^[9] from Lahore and from Peshawar by Aslam and Barnett^[10,11] but morphometric measurements and illustrations of taxonomic characters were not furnished by these authors. Lewis^[12] reported this species from Gujrat, Rawalpindi, Saidpur, Saidu Sharif and Taxilla but characteristics like wing, hypopharynx, maxilla, mandibles, palp antennal segments, genital atrium and genital furca were not illustrated. Measurements of diagnostic characters like cibarium, pigment patch, pharynx, coxite, style, paramere, aedeagus, surstyle, spermatheca, genital atrium and genital furca were also not furnished. These taxonomic characters of Pakistani form were unknown in the literature. Artemiev^[3] too, while reporting *S. indica* from Afghanistan did not supply measurements of wing, A4, A5, palp, pharynx, ♂ terminalia and ♀ genitalia nor figures of wing, antennal segments, palps, labrum, hypopharynx, maxilla, mandible, pharynx, genital pump and filament were furnished. Rab *et al.*^[13] reported *S. squamipleuris* from Uthal, Balochistan and Burney and Lari^[14] also reported this species from Balochistan but its taxonomic characters were not reported by these authors. Ilango *et al.*^[15] while describing

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S. indica (= *G. indica*) from southern India did not provide diagrams of wing, palp, labrum, hypopharynx, mandible, A4, A5 and pharynx. Measurements of pigment patch, pharynx, paramere, aedeagus and spermatheca were not provided. Aslam^[16] reported this species from a single locality, Dera Bugti, Balochistan, but did not provide measurements, account and figures of taxonomic characters of this species. To fill this gap of knowledge, an extensive taxonomic study for the identification of the species of sandflies was carried out by the present author in the whole of the Balochistan Province during 1996-2001 and collected 2013 sandflies comprising of genera *Phlebotomus*, *Sergentomyia* and *Grassomyia*^[17]. In view of the insufficient descriptions of Artemiev^[3], Aslam and Barnett^[11], Burney and Lari^[13], Ilango *et al.*^[15], Lewis^[12], Perfiliev^[2], Rab *et al.*^[14], Sinton^[6], Sobti^[9], Theodor^[8], Theodor and Mesghali^[1] (loc. cit.), *G.d. turkestanica* and *G. indica* are redescribed in detail in the present paper. 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.*^[18-22] were followed. For the species identification of sandflies, keys furnished by Artemiev^[3,12,23-26] 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, Pakistan.

RESULTS

Grassomyia dreyfussi turkestanica Theodor and Mesghali^[1]. *Sergentomyia* (*Grassomyia*) *dreyfussi turkestanica*, Theodor and Mesghali^[1], J. Med. Ent., 1: 295; Artemiev^[3]: 31. *S. squamipleuris karakalensis* Perfiliev^[2], synonymized by Artemiev, 1978: 31. {Lewis^[27], Syst. Ent., 12:165 raised subgenus *Grassomyia* to genus}.

Female: 22 specimens were examined (Fig. 1). Small and dark sandfly. Femoral spines are often found lost and their sockets look like those of large hairs. In 3 specimens from Khuzdar and 1 from Dera Allahyar, femur 1 is observed with spines and with sockets of spines. In one specimen, five femoral black spines (each about 0.02 mm long) are observed arranged laterally at a distance of 0.04 mm and

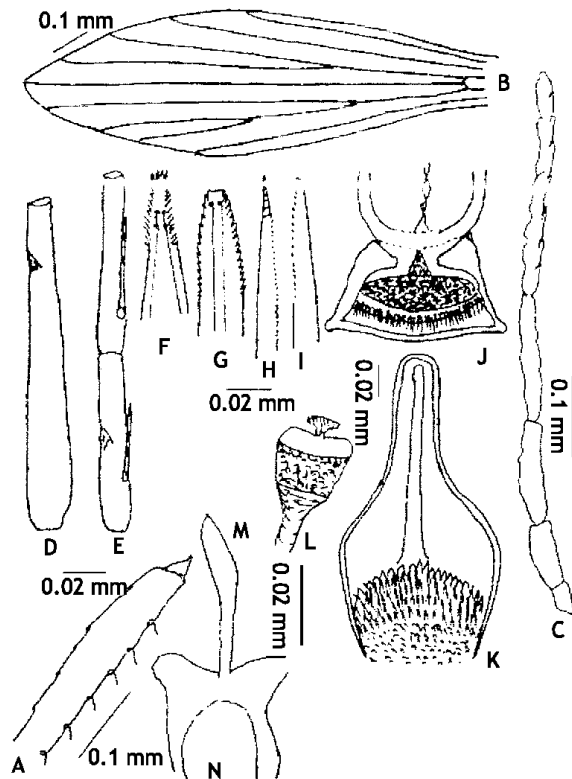


Fig. 1: Camera Lucida drawings of *Grassomyia dreyfussi turkestanica* (♀) from Balochistan showing: femora (A), wing (B), palp (C), the third (D), fourth (E, lower) and fifth (E, upper) antennal segments, labrum (F), hypopharynx (G), maxilla (H), mandible (I), cibarium (J), Pharynx (K), spermatheca (L), genital furca (M), genital atrium (N)

seven sockets were also found (Fig. 1A). Eye 0.168–0.176 mm long, 0.44–0.456xlength of head, 0.104–0.112 mm broad, 0.152–0.168 mm distance between eyes. Head 0.368–0.4 mm long, 0.36–0.368 mm broad. Wing (Fig. 1B) 1.32–1.44 mm long, 0.36–0.40 mm broad, α =0.256–0.30 mm, β =0.256–0.28 mm, δ =0.16 mm, γ =0.28–0.36 mm. π =0.06–0.08 mm, alar index=1.0–1.071. Proboscis 0.17–0.18 mm long. Palp (Fig. 1C) 0.52–0.56 mm long, palpal formula=1, 2, 3, 4, 5 and palpal ratio=1: 3.4:5.4:6.8:10.5. A3 (Fig. 1D) 0.14–0.17 mm long, 0.106–0.118xlength of wing, 0.823–0.944xlength of proboscis, 1.166–1.214xlength of labrum, 0.921–0.934xlength of A4+5. A4 (Fig. 1E, lower) 0.076–0.090 mm long, ascoid on A4=0.036–0.04 mm long, ascoid 4/A4=0.44–0.473. A5 (Fig. 1E, upper) 0.076–0.092 mm long, ascoid on A5=0.04–0.042 mm long and ascoid 5/A5=0.456–0.526. Antennal segments III and

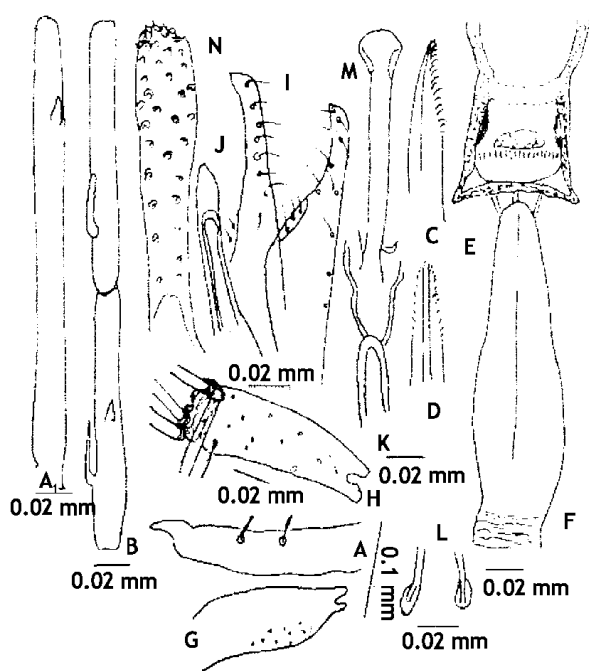


Fig. 2: Camera Lucida drawings *Grassomyia dreyfussi turkestanica* (♂) from Balochistan showing: femora 1 (A), the third (A 1), fourth (B, lower) and fifth (B, upper) antennal segments, labrum (C), hypopharynx (D), cibarium (E), pharynx (F), coxite (G), style (H), paramere (I). Aedeagus (J), genital filament (K), dilated ends of filament (L), pump (M), surstyle (N)

IV have a single prominent papilla (Fig. 1D, E). On A4 it is usually at the opposite side of ascoid, but is anterior to the base of the ascoid and posterior to the tip of ascoid. Papilla formula is 1/3-4. The positions of papilla on segments are: AIII, 0.81 and AIV, 0.633. The positions of ascoids on segments are: AIV, 0.39 and AV, 0.24. There are one ascoid on segments IV to XV. Labrum (Fig. 1F) 0.12-0.14 mm long, with three median apical sensilla and about 21 lateral sensilla, sensilla depth 0.033 mm. Hypopharynx (Fig. 1G) apical and lateral margins weakly undulating, a dental depth of 0.04 mm. Maxilla (Fig. 1H) with sharp and thin apical part (0.009 mm long) with 6 lateral and 23 ventral teeth, a dental depth of 0.028 mm. Mandible (Fig. 1I) narrow (0.005 mm broad) with 4 small re-curved denticles per 0.004 mm, a dental depth of 0.032 mm. Cibarium (Fig. 1J) 0.07-0.08 mm broad, chitinous arch developed at margins but ill developed at center, posterior to it lateral walls of cibarium form triangular inward projections (0.014 mm long, 0.016 mm broad), pigment patch very dark (0.054-0.060 mm long, 0.05 mm broad) with a short anterior process (0.014-0.02 mm long), a

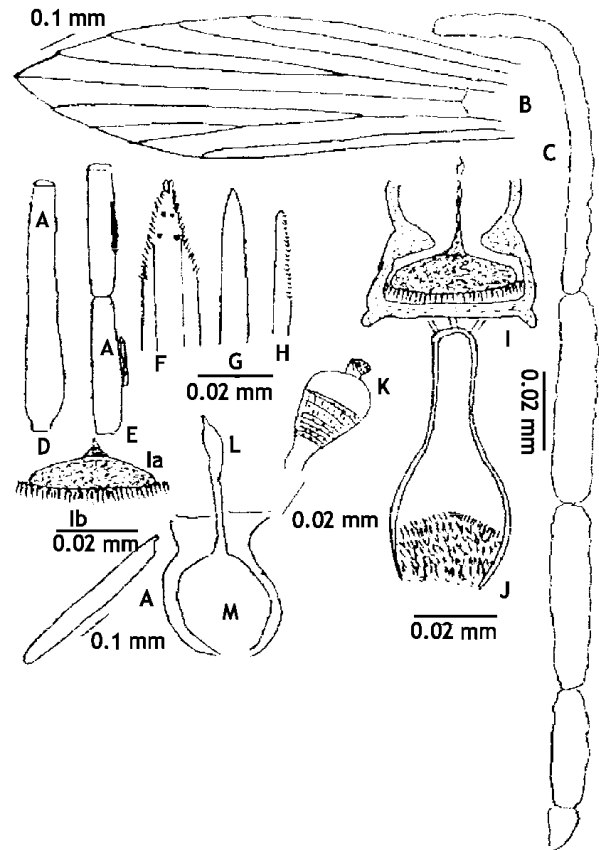


Fig. 3: Camera Lucida drawings of *Grassomyia indica* (♀) from Balochistan showing: Femora 1. without spine (A), wing (B), palp (C), the third (D), fourth (E, lower) and fifth (E, upper), labrum (F), hypopharynx (G), mandible (H), cibarium (I), pigment patch (I.a.), cibarial teeth (I.b), pharynx (J), spermatheca (K), genital furca (L), genital atrium (M)

concave row (0.064 mm long) of about 32-34 min rounded chitinous denticles at posterior margin of pigment patch, posterior to denticles about 40-44 uniform teeth (each tooth about 0.008 mm long) arranged in an almost concave row (0.068 mm long), tooth of hind part (0.004 mm long) relatively thicker whereas teeth of remaining forepart (each tooth=0.004 mm long) are comparatively thinner. Pharynx (Fig. 1K) very typical, characteristically flask shaped, 0.14-0.16 mm long, length of pharynx 2 times its hind width, fore width 0.020-0.025 mm, posterior width 3.2-3.5 times fore width, pharynx very wide and long necked flask shaped with a wide bulge posteriorly (0.07-0.08 mm broad) which finally less constrict at base (0.046-0.048 mm broad). The anterior edge of armature forms a sharp convex line and at median apical end armature is 0.04-0.05 mm of height whereas

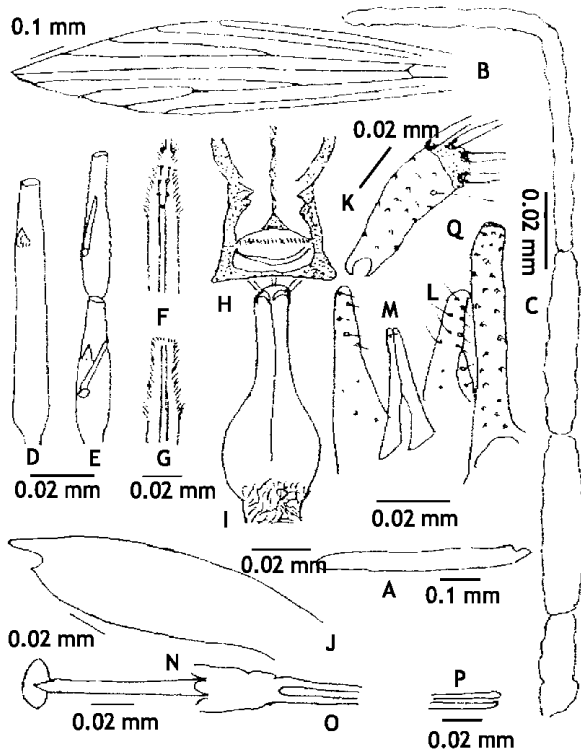


Fig. 4: Camera Lucida drawings of *Grassomyia indica* (♂) from Balochistan showing: Femora I. without spine (A), wing (B), palp (C), the third (D), fourth (E, lower) and fifth (E, upper), labrum (F), hypopharynx (G), cibarium (H), pharynx (I), coxite (J), style (K), paramere (L), aedeagus (M), genital pump (N), filament (O), less dilated ends of filament (P), surstyle (Q)

armature at lateral sides 0.03 mm height, which almost does not touch the side walls of pharynx, antero central part of armature was about 0.026–0.032 mm height and consisted of large erect spines (mostly each about 0.005 mm long), whereas hind and basal part 0.014–0.018 mm of height, composed of shorter but weak spines, pharyngeal armature occupies 0.285–0.312xlength of pharynx. Spermatheca (Fig. 1L) with a characteristic morphology, not egg shaped, 0.028–0.030 mm long, fore width and basal width were almost equal (0.024 mm broad), central breadth of capsule, 0.034 mm, anterior smooth part of capsule 0.010 mm broad whereas distal part 0.012 mm broad consist of irregular rows of minute chitinous scales. Apical part of the spermatheca with small hair like brush of tubules (0.009 mm long, 0.012 mm broad), genital fork (Fig. 1M) 0.064 mm long and genital atrium (Fig. 1N) 0.04 mm broad.

Male: 2 specimens were examined (Fig. 2). Wing 1.04 mm long, 0.24 mm broad, $\alpha=0.136$ mm long,

$\beta=0.256$ mm long, $\delta= -0.04$ mm, $\gamma=0.224$ mm long, $\pi=0.064$ mm, alar index=0.531. Palp 0.48 mm long, palp ratio 1, 3, 4.5, 5.5, 10, palp formula 1, 2, 3, 4, 5. Femur with 2 short spines (Fig. 2A). A3 (Fig. 2A1) 0.16 mm long, $A3/\text{labrum} = 1.45$, $A3 < A4+5$. A4 (Fig. 2B, lower) 0.09 mm long, ascoid 0.02 mm long, position of ascoid on A4 0.227, position of a single papilla on A4=0.61, ascoid $4/A4=0.222$. A5 (Fig. 2B, upper) 0.09 mm long, ascoid 0.02 mm long, position of ascoid on A5 0.245, position of a single papilla on A5=0.57. Antennal ascoid formula 1/IV-XV. Labrum (Fig. 2C) 0.11 mm long and a sensilla depth of 0.024 mm. Hypopharynx (Fig. 2D) apex pointed, a dental depth of 0.02 mm. Cibarium (Fig. 2E) 0.044 mm broad, chitinous arch ill developed but developed at sides, anterior process absent, lateral edges of cibarium well developed, about 20 small teeth on an almost straight line and above the teeth, a small pigment patch is present. Pharynx (Fig. 2F) 0.11 mm long and is about 3 times as long as posterior greatest breadth which is about 1.8 times as wide as narrow anterior part. Pharynx is not markedly dilated posteriorly. Most of the weak armature is in the form of irregular rows and occupied the posterior part behind the pharyngeal bulb. Armature is about 4.2 times of length of pharynx. Coxite (Fig. 2G) 0.18 mm long and 0.056 mm broad. Coxite length/breadth=3.21, coxite/style=2.25, coxite/labrum=1.63, coxite/A3=1.125. Style (Fig. 2H) 0.08 mm long and 0.022 mm broad with 2 apical and 2 sub apical spines at 0.87, a short ventral seta at 0.9. Paramere (Fig. 2I) 0.12 mm long, base of the body of paramere 0.05 mm broad while neck is narrow (0.02 mm broad) and beaked. Aedeagus (Fig. 2J) short, 0.07 mm long, apex broad, like a broad knife apex. Genital filament (Fig. 2K) smooth, 0.34 mm long, with dilated ends (Fig. 2L) and pump (Fig. 2M) 0.1mm long, Filament /Pump=3.4. Surstyle (Fig. 2N) 0.16 mm long and 0.88xlength of coxite.

Distribution: Balochistan. Present survey, New record: Adampur, Bela, Dera Allahyar, Dhadar, Duki, Hairdin, Kahan, Khuzdar, Kohlu, Nanasaheb ziarat, Parom, Sibi, Turbat, Usta Muhammad. These localities are important foci of cutaneous leishmaniasis. Sandflies were collected using mouth aspirators and sticky traps from indoors and out doors.

Grassomyia indica Theodor^[8]. *Phlebotomus squamipleuris* Newstead^[4], Bull.Ent. Res., 3: 366; Sinton^[5], Indian J. Med. Res.,11: 65; 1924, 813. *Phlebotomus squamipleuris* var. *indicaus* Theodor^[8]. Bull. Ent. Res., 22: 470. *Sergentomyia squamipleuris* var. *indica* (Theodor), Theodor^[28], Bull. Ent. Res., 39: 112. *Phlebotomus (Grassomyia) squamipleuris indicus* Theodor, Abonnenc^[29]: 114. *Sergentomyia (Grassomyia) squamipleuris indica* (Theodor), Lewis^[12]: 34.

Sergentomyia (Grassomyia) indica (Theodor), Theodor and Mesghali^[1], J. Med. Ent., 1: 295, Lewis^[23] Bull. Brit. Mus. Nat. Hist. (Ent.), 37: 268, Artemiev^[3]: 32. *Grassomyia indica* (Theodor), Lewis^[27], Syst. Ent., 12: 165 [raised subgenus *Grassomyia* to genus].

Female: Twenty nine specimens were examined (Fig. 3). Head 0.32–0.36 mm long, 0.32–0.34 mm broad, eye=0.16–0.192 mm long, 0.5–0.533x length of head, 0.096–0.112 mm broad, distance between eyes 0.128–0.144 mm. Femora 1 (Fig. 3A) without spine. Wing (Fig. 3B) 1.28–1.36 mm long, 0.31–0.36 mm broad. $\alpha=0.23-0.272$ mm, $\beta=0.24-0.28$ mm, $\delta=0.112$ mm, $\gamma=0.28$ mm, $\pi=0.064-0.072$ mm, alar index 0.958–0.971. Proboscis 0.15–0.17 mm long. Palp (Fig. 3C) 0.48–0.51 mm long, palpal formula 1, 2, 3, 4, 5, palpal ratio 10:30:50:57.5:102. A3 (Fig. 3D) 0.12–0.14 mm long, 0.093–0.102xlength of wing, 0.80–0.823xlength of proboscis, 1.0–1.07xlength of the labrum, 0.827–0.853xlength of A+5. A4 (Fig. 3E, lower) 0.07–0.08 mm long, ascoid on A4=0.02 mm, ascoid 4/A4=0.25–0.285. A5 (Fig. 3E, upper) 0.075–0.084 mm long, ascoid on A5=0.024 mm long and ascoid 5/A5= 0.285–0.32. Antennal segments III and IV have a single prominent papilla (Fig. 3D-3E). On A4, it is usually at the opposite side of ascoid but is anterior to the tip of the ascoid. Papilla formula 1/3–4. The positions of the papillae on segments are: A3, 0.852 and AIV, 0.732. The positions of ascoids on segments are: AIV, 0.267 and AV, 0.294. There is one ascoid on segments IV to XV. Labrum (Fig. 3F) 0.12–0.13 mm long with 2 median strong apical sensilla, laterals are relatively long, sensillae depth 0.04 mm. Hypopharynx (Fig. 3G) apical margin pointed and lateral margins smooth. Mandible (Fig. 3H) narrow, 5 re-curved small teeth per 0.004 mm, a dental depth of 0.044 mm. Cibarium (Fig. 3I) 0.034–0.036 mm broad, chitinous arch absent, lateral walls of cibarium thick and highly pigmented and with inward triangular extension (0.016 mm long and 0.019 mm broad), pigment patch very dark (Fig. 3Ia) 0.062 mm long and 0.024 mm broad with a forward median extension (0.016 mm long) which finally attach with a long anterior process, a row of black dot like denticles at the hind base of the teeth and posterior to denticles 40-48 almost uniform small teeth closely arranged on a slightly concave row (Fig. 3Ib). Pharynx (Fig. 3J) 0.13–0.14 mm long, 2.153–2.166xhind width, fore width 0.022–0.030 mm, posterior width 2.166–2.72 times fore width. The anterior edge of armature forms a convex line, armature 0.04–0.042 mm height and occupies 0.3–0.307xlength of pharynx, antero central armature strong and yellow pigmented, whereas the basal armature relatively faint and weak, basal part of the pharynx constricted 0.034–0.44 mm broad. Spermatheca (Fig. 3K)

almost egg shaped, 0.04-0.044 mm long, fore width 0.024 mm, hind width 0.032 mm, basal width 0.012 mm, anterior part of the body of spermathecal capsule smooth, whereas distal hind part with transverse striations, genital furca (Fig. 3L) 0.08 mm long, genital atrium (Fig. 3M) 0.048 mm broad.

Male: 21 specimens were examined (Fig. 4). Small and dark sandfly. Femora 1 without spine (Fig. 4A) Head 0.36-0.376 mm long, 0.32-0.34 mm broad. Eye 0.144-0.16 mm long, 0.11-0.15 mm broad, 0.186-0.19 mm distance between eyes. Wing (Fig. 4B) narrow, 1.20-1.24 mm long, 0.24-0.28 mm broad. $\alpha=0.20-0.24$ mm long, $\beta=0.264-0.28$ mm long, $\delta=0.08$ mm, $\gamma=0.24-0.27$ mm long, $\pi=0.049-0.08$ mm, alar index=0.757-0.857. Palp (Fig. 4C) 0.48-0.53 mm long, palpal formula 1, 2, 3, 4, 5 and palpal ratio 10: 22: 40: 48: 82.

Proboscis 0.14 mm long. A3 (Fig. 4D) 0.11-0.13 mm long, 0.305-0.345xlength of head, 0.091-0.104xlength of wing, 0.785-0.928xlength of proboscis, 1.375-1.444xlength of labrum, 0.733-0.802xlength of A4+5. A4 (Fig. 4E, lower) 0.07-0.080 mm long, ascoid on A4=0.025-0.028 mm long and ascoid 4/A4=0.35-0.357. A5 (Fig. 4E, upper) 0.076-0.086 mm long, ascoid on A5=0.025-0.028 mm long, ascoid 5/A5=0.325-0.328. Antennal segments III and IV have a single papilla. On A4 it is usually at the side of ascoid but it is at about half-length of the length of the ascoid. The positions of the papilla on segments are: A III, 0.785 and A IV, 0.6. The positions of ascoids on segments are: AIV, 0.293 and AV, 0.296. There is one ascoid on segments IV-XV. Labrum (Fig. 4F) 0.08-0.09 mm long, median apical margin with 2 relatively long but weak sensilla whereas laterals are comparatively shorter, a sensilla depth of 0.032 mm. Hypopharynx (Fig. 4G) median apical part with 5-7 closely arranged sensilla like and relatively shorter teeth whereas laterals are sharply pointed and comparatively longer teeth not arranged closely but with maintaining a little distance between one another. Cibarium (Fig. 4H) 0.05 mm broad, chitinous arch absent, lateral walls of cibarium with triangular inward projections (0.012 mm long, 0.08 mm broad), a small median pigment patch 0.018 mm long with a long anterior process, about 20-24 small teeth arranged in an almost straight line. Pharynx (Fig. 4I) 0.12-0.125 mm long, 2.60-3.0 times hind width, fore width 0.016-0.024 mm, posterior width 2.0-2.5 times fore width, basal breadth 0.024-0.032 mm. Pharyngeal armature very faint and weak and situated mostly at the basal part of the pharynx. Height of pharyngeal armature 0.024 mm. Coxite (Fig. 4J) 0.18-0.19 mm long 0.052-0.06 mm broad, coxite length/breadth=3.16-3.46, coxite/style=2.11-2.25, coxite/labrum=2.11-2.25, coxite/A3=1.46-1.63. Style (Fig. 4K) 0.08-0.09 mm long, 0.026-0.028 mm broad, distal

end of style was slightly broader than rest of the body, a long seta (0.03 mm) at 0.76 of the style, style with 2 apical and 2 sub apical spines. Paramere (Fig. 4L) 0.11-0.13 mm long, 0.034-0.036 mm broad, with a ventral tubercle (0.02 mm long, 0.01 mm broad) having 2 short spinules, paramere with narrow blunt end. Aedeagus (Fig. 4M) 0.08-0.09 mm long, shaft and tip of the aedeagus relatively thinner than aedeagus of *G. turkestanica* {Theodor and Mesghali^[1], present study} the shank of the aedeagus was normal and not bulbous, one spine present closer to the tip of the aedeagus. Genital pump (Fig. 4N) the terminal pavilion (0.024 mm long, 0.015 mm broad), median spicule present, pump 0.125 mm long, genital filament (Fig. 4O) 0.36-0.40 mm long with less dilated ends (Fig. 4P), with F/P=2.88-3.2. Surstyle (Fig. 4Q) 0.16-0.17 mm long, 0.888-0.894xlength of coxite.

Distribution: Balochistan. Present survey, New record: Adampur, Bela, Dera Allahyar, Dhadar, Duki, Hairdin, Khuzdar, Kohlu, Nal, Nanasaheb ziarat, Panjgour, Sibi. These localities are important foci of cutaneous leishmaniasis. Sandflies were collected using mouth aspirators and sticky traps from indoors and out doors. Dera Bugti^[16].

Key for the identification of Pakistanese species *Grassomyia d. turkestanica* and *Grassomyia indica*: The spermatheca and the expanded tips of the genital filaments..... Genus *Grassomyia*
 32-34 min tounded chitinous denticles at the posterior margin of the pigment patch and posterior to dennticles are 40-44 uniform cibarial teeth arranged on an almost concave row, A3= 0.14-0.17 mm long, anterior femur with short but stout spines, spermatheca cylindrical..... ♀ *G.d. turkestanica*
 Posterior to denticles are 40-48 small teeth on slightly concave line, A3=0.12-0.14 mm long, femur without spine, spermatheca egg-shaped ♀ *G. indica*
 Cibarium with 20 small teeth on an almost straight line, femur with spines, A3=0.16 mm long, filaments with dialated ends..... ♂ *G.d. turkestanica*
 20-24 small cibarial teeth on a straight line, femur without spine, A3= 0.11-0.13 m long, filaments with less dialated ends..... ♂ *G. indica*.

DISCUSSION

The morphology and measurements of various characters of *G. d. turkestanica* show considerable differences when compared with the published data of this species from other territories (Table 1). Balochistan ♀ specimens are found showing a slightly shorter A3, A3/labrum, coxite, style and F/P as compared with the

published data of this species from Afghanistan^[3]. Further fewer number of cibarial teeth are found in Pakistani forms as compared with Afghanistan form^[3]. However, morphology of other characters like femur 1 with short spines, pigment patch, paramere with blunt but slightly hooked end, aedeagus knife shaped and genital filament with dilated ends of Pakistani form are found in full accord with the published data of this species from Afghanistan^[3]. Similarly, other taxonomic characters like uniform cibarial teeth arranged in a straight row, dark and broad pigment patch with a short anterior process, lateral walls of cibarium with triangular inward projections, ascoid formula 1 / 4-15, bottle shaped wide pharynx and cylindrical spermatheca not egg shaped of ♀ Pakistani forms are found similar to that of published data of this species from Afghanistan^[3]. However, A3 and A3/labrum in Pakistani flies are measured a slightly shorter than Afghanistan forms^[3]. A slightly greater number of cibarial teeth are found in Pakistani ♀ form as compared with Afghanistan specimens^[3]. Character A3 in Pakistani ♀ flies is measured a slightly shorter than A3 of Iranian specimens^[1]. However, other characters like number of cibarial teeth, A3/labrum, figures of cibarium, pharynx and spermatheca of Iranian flies furnished by Theodor and Mesghali^[1] are found similar to that of Pakistani forms.

Theodor and Mesghali^[1] recognized four species: *S. dreyfussi*, *indica*, *inermis* and *squamipleuris* and described very unusual species *S. d. turkestanica* from Turkistan and Central Iran. Lewis^[23] quoted that Perfiliev in a letter to him, informed that *S.s. karakalensis* from Soviet Central Asia was a synonym of *S.d. turkestanica*.

The morphology and measurements of various taxonomic characters of *G. indica* show considerable differences when compared with the published data of this species from other territories (Table 2). Balochistan form are found to have a little wing index (♂:0.757-0.857, ♀:0.958-0.971) as compared with the data reported by Theodor^[8] in Indian forms of *P. squamipleuris* var. *indicus* (0.87-1.0). However, Balochistan forms are found similar in characters like a relatively shorter A3, A3<A4+5, elongated flat pigment patch and well marked narrower posterior basal part of pharynx and over all drawing of pharynx as compared with the data published by Theodor^[8]. The other remarkable variant character is 40-48 uniform cibarial teeth in female flies of Balochistan as compared with 33-36 cibarial teeth in the Indian from reported by Theodor^[8].

Characters like, more narrower wings, alar index, labrum, A3 and genital filament of Balochistan ♂ specimens are observed a little shorter as compared with southern Indian forms^[15]. Similarly, a relatively larger ratio of ascoid 4/A4 and Filament / Pump of Balochistan specimens are found as compared with southern Indian

Table 1: Comparative taxonomic characters (mm) of *Grassomyia drexfussi turkestanica* Theodor and Mesghali from Balochistan and the published data of this species from other territories

♀ Taxonomic characters	Balochistan (Present survey)	Iran and Turkestan ^[1]	<i>S. s. karakalensis</i> Synonym, from Turkmenistan ^[2]	Afghanistan ^[3] [in μ.m.]
Wing Length	1.32-1.44		1.51-1.84	
Breadth	0.36-0.40	-	0.36-0.42	-
A3 Length	0.14-0.17	0.20-0.22	0.16-0.20	172-192
A3/A4+5	A3<A4+5		A3<A4+5	
A3/labrum	1.166-1.214	1.1-1.2		1.1-1.4
Antennal ascoid formula	1/4-15	-	-	1/4-15.
Cibarium	40-44 uniform teeth, pigment patch dark and very broad with short anterior process, chitinous arch ill developed, lateral walls of cibarium with triangular inward projections.	40 teeth	28-38 uniform teeth on a line convex posteriorly, teeth with long points, a row of punctiform denticles at the base of cibarial teeth, pigmented area large, dark and triangular.	Convex row of 37-44 teeth, pigment patch dark and very broad, with short anterior process, chitinous arch well developed, lateral walls of cibarium with triangular inward projections.
Pharynx	Pharynx bottle shaped, wide.	-	Pharynx with markedly convex walls, pharynx about twice as wide posteriorly as anteriorly, armature situated in posterior narrow part of pharynx extending into wide part of pharynx	Pharynx bottle shaped, wide.
Spermatheca	Spermatheca not egg shaped, distal part composed of rows of chitinous spicules, proximal part smooth.	-	Spermatheca with round capsule with rows of spinules, about less than half length of capsule without spinules.	Spermatheca cylindrical, short, with numerous yellow spinules on lateral surface.
Femur	Femur 1 with spines	-	The fore femur bears 3 or 4 short pointed spines on a large base.	-
♂ Taxonomic characters				
Wing Length	1.20-1.30		1.5-1.6	
Breadth	0.25-0.30	-	0.33-0.35	-
A3 Length	0.12-0.15		0.14-0.16	176-230
A3/A4+5	A3<A4+5		A3<A4+5	1.29-1.50
A3/labrum	1.09-1.25	-		
Antennal ascoid formula	1/4-15	-		1/4-15.
Ascoid 4/A4	0.277-0.285	-	½ length of the segment.	-
Labrum Length	0.11-0.12	-	0.13-0.15	-
Cibarium	17-19 small teeth in a straight row, pigment patch small, chitinous arch ill developed.	-	16-18 similar teeth on a straight line, a row of minute punctiform denticle present anterior to cibarial teeth, pigmented area small, irregularly rounded or absent.	18-27 small teeth in convex or straight row, pigment patch small, chitinous arch developed.
Coxite Length	0.16-0.17	-	0.18-0.21	180 - 210.
Style Length	0.078-0.08	4 spines, 2 terminal, 2 sub terminal.	0.085-0.091	85-100 long, with two spine terminal and two sub terminal.
Femur 1	Femur 1 with short spines	-	-	Femur 1 with short spines
Paramere	Paramere with narrow blunt hooked end.	-	-	Paramere with blunt hooked end
Aedeagus	Aedeagus knife shaped.	-	-	Aedeagus knife shaped
Genital filament F/P	Genital filaments with dilated ends.	-	-	Genital filament with dilated ends.
	2.92-3.18	-	-	2.97-3.71.

forms^[15]. In both the sexes of the fly, ascoid formula [1/3-15] of Balochistan forms is found similar as reported from India^[15]. Further, an almost similar number of cibarial teeth (20) are noted in flies of both Balochistan and Indian forms^[15].

Balochistan ♀ forms are found having a shorter wing, alar index, labrum, ascoid 4/ A4 as compared with southern Indian forms^[15]. 40-48 uniform cibarial teeth were observed in Balochistan ♀ flies where as 34-45 cibarial teeth are reported from southern India by Ilango *et al.*^[15]. However, Balochistan specimens are found in full accord with southern Indian forms^[15] in characters like antennal

segments 3 and lateral walls of cibarium with inward projections. Balochistan ♂ forms are observed very much similar with Afghanistan specimens^[3] in characters like having a similar number of cibarial teeth (20-24), chitinous arch ill developed, pigment patch small, paramere with blunt end. In ♀ flies also, ascoid formula 1/4-15, chitinous arch absent and egg shaped spermatheca were observed almost similar with the published data of this species from Afghanistan^[3]. A slight differences and interesting similarities are observed in Balochistan specimens with the published data of this species from Punjab and N.W.F.P.^[12]. A shorter wing, labrum, A3 and F/P and a

Table 2: Comparative taxonomic characters (mm) of *Grassomyia indica* Theodor from Balochistan and the published data of this species from other territories

♀ Taxonomic characters	Balochistan (Present study)	Punjab, N.W.F.P. Pakistan ^[12]	Southern India ^[3]	Afghanistan (µm) ^[3]
Anterior Femora	Without spines	Without spines	-	-
Eye Length	0.16–0.192	-	0.497 (0.485–0.515)	-
Eye/head	0.5–0.533xlength of head	-	0.571xlength of head	-
Wing Length	1.28–1.36	1.65 (1.52–1.74)	1.606 (1.512–1.68)	-
Breadth	0.31–0.36	0.38 (0.35–0.42)	4.356 (4.14–4.66)	-
Alar index	0.958–0.971	0.9 (0.7–1.1)	0.843 (0.58–1.0)	-
Labrum Length	0.12–0.13	0.15 (0.14–0.17)	0.145 (0.135–0.157)	-
A3 Length	0.12–0.14	0.14 (0.13–0.15)	0.137 (0.126–0.144)	0.13–0.168
A3/labrum	1.0–1.07	0.9–1.1	-	0.9–1.1
A3/A4+5	A3<A4+5	A3<A4+5	-	-
Ascoïd 4/A4	0.25–0.285	0.3 or 0.4	0.405 (0.35–0.476)	-
Ascoïd Formula	1/4 - 15	1/3 - 15	1/3 - 15	1/4 - 15
Palpal ratio	10 : 30 : 50 : 57.5 : 102	10 : 11 : 13.	10 : 12 : 20 : 22 : 42.	-
Formula	1, 2, 3, 4, 5	1, 2, 3, 4, 5	-	-
Cibarium	With 40–48 uniform teeth, chitinous arch absent, a row of dot like denticles at the base of teeth, lateral walls of cibarium with inward projections, pigment patch broad and dark.	34–48 teeth in a posteriorly convex row, a line of punctiform teeth at their bases, chitinous arch weakly developed, wall of cibarium with inward projections, pigment patch broad and dark.	41 (34–45) teeth	A convex row of 34–48 teeth, chitinous arch absent.
Spermatheca	Egg shaped with smooth proximal part and distal part with transverse striations.	Surface of spermatheca smooth near its apex.	-	Egg shaped with smooth distal part and with transverse striations based.
♂ Taxonomic				
Anterior Femora	Without spines	-	-	Without spines
Wing Length	1.20–1.24	1.49 (1.42–1.61)	1.48	-
Breadth	0.24–0.28	0.31 (0.29–0.34)	-	-
Alar index	0.757–0.857	-	0.9	-
Labrum Length	0.08–0.09	-	0.14	-
Labrum/wing	0.06–0.07	0.13 (0.13–0.14)	0.09	-
A3 Length	0.11–0.13	0.15 (0.14–0.16)	0.15	140–172
A3/labrum	1.375–1.444	1.1–1.2	-	1.03–1.23
A3/A4+5	0.733–0.802	A3<A4+5	0.8	-
A3/ wing	0.091 0.104	-	-	-
Ascoïd 4/A4	0.35–0.357	0.30	0.3	-
Ascoïd Formula	1/4–15	-	1/3–15	-
Palpal ratio	10 : 22 : 40 : 48 : 82.	-	10 : 18 : 33 : 35 : 36	-
Formula	1,2,3,4,5	-	-	-
Cibarium	20–24 teeth, chitinous arch ill developed or absent. Lateral walls of cibarium with inward projections, pigment patch small	22 teeth on a line slightly convex posteriorly, chitinous arch not very definite, lateral walls of cibarium with inward projections, pigment patch present.	20 teeth	20–24 teeth, chitinous arch poorly developed or absent, pigment patch small.
Coxite Length	.18–0.19	-	0.19	-
Coxite/style	2.11–2.25	-	2.3	-
Style	Style with 2 apical and 2 sub apical spines	Style with two apical and two sub apical spines	-	-
Seta at	0.76	0.75	-	-
Paramere	Paramere with blunt end	With rounded ends	-	Paramere with blunt end.
Aedeagus	Shaft of the aedeagus thinner.	Aedeagus curved up forward and narrows abruptly to a rounded end	-	-
Genital filament with less dilated ends	0.36–0.40 long, 2.88–3.2 x length of pump, filament with less dilated ends	Genital filament about 4 times pump length with expended ends.	0.41 long, 3.0xlength of sperm pump.	-

larger ratio of A3/labrum and ascoïd 4/A4 are observed in ♂ specimens of Balochistan. However, characters like A3 < A4+5, lateral walls of cibarium with inward projections, seta at about 0.75–0.76, paramere with blunt end, aedeagus narrow and genital filament with less dilated ends are found in full resemblance with the published data of this species from Punjab and N.W.F.P.^[12]. ♀ specimens

from Balochistan are found with a shorter ascoïd 4/A4, A3 < A4+5 and egg shaped spermatheca are in full accord with the data and figures furnished by Lewis^[12] from northern part of the country.

Theodor and Mesghali^[1] suggested that a number of Central Asiatic species have entered Iran from Turkestan. Since Pakistan is situated at the junction of the Oriental

and Palaearctic Region with inclusion of Mediterranean sub region and incursion of the Ethiopian Region^[30,31] in south western part of the country, probably made it possible the distribution of *G.d. turkestanica*, in this region. *S. dreyfussi* is known only from North Africa, Ethiopia whereas *G.d. turkestanica* so far from Iranian Balochistan and Turkistan. The results of the present study show that *G. d. turkestanica* is a rare species (53/2013, 2.69%) and has a discontinuous distribution in Pakistan. There are no published reports incriminating *G.d. turkestanica*, which is thought to be rather thermophilic, very hydrophilic and prefer to suck blood of toads and frogs^[3] and presumably plays no part in transmitting *Leishmania* to man.

The results of the present study show that *G. indica* is a rare Oriental species (54/2013, (2.69%) and is discontinuously distributed in Pakistan. However, Balochistan represents the western limits of the range of this Oriental species. There are no published reports incriminating *G. indica* which is thought to be more thermophilic, not resistant to cold winter^[3] and presumably plays no part in transmitting *Leishmania* to man.

ACKNOWLEDGMENTS

The author wishes to thank Professors Drs. R. Killick-Kendrick, David J. Bradley, R. W. Ashford, R. P. Lane and David A. Evans (England) for their encouragement and valuable guidance. My sincerest thanks are also due to respected Joanna Kapusta (BMNH), Linda Huddleston (BMNH), Prof. Dr. J.-P. Dedet (France), Dr. Farrukh Muddaber (WHO) and Prof. Dr. V. N. Neronov (Russia) for providing me literature on sandflies.

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