

Studies on three Indian species of Genus *Parasarcophaga* Johnston and Tiegss (Diptera: Sarcophagidae)

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Abstract

The present study was hinge on the specimens of Sarcophagidae family during the collection cum survey tours undertaken from July, 2011 to June 2012 in five states of northern India. The male genitalia of three species belonging to the genus *Parasarcophaga* Johnston and Tiegss, i.e., *sericea* (Walker), *miseria* (Walker) and *hirtipes* (Wiedemann) have been studied in detail. The present work includes the descriptions and detailed illustrations of external male genitelic structures which have not been published so far these three species. A key to the studied species is also given.

Keywords: Diptera, male genitalia, Oestroidea, *Parasarcophaga*, Sarcophagidae

Introduction

Taxonomic studies on sarcophagid flies remained poorly undertaken in India and adjacent countries till 1920s. Senior-White ^[1] revised these flies from the Oriental region and described several new species. Extensive faunistic exploration was done in India and 163 species of Sarcophagidae have been recorded from different states and union territories of the country by Nandi ^[2]. In India, Sarcophagidae family consists of 126 species, out of which 89 species are from the genus *Sarcophaga* which amounts for 70% of the Indian Sarcophagidae family. The genus *Blaesoxipha* consist of 9 species which amounts for 7% of the Indian Sarcophagidae family ^[3]. Sarcophagidae comprises a group of medium sized to fairly large flies of 4 mm to 18 mm length that are widely distributed all over the world except the arctic region. Abdomen may have silvery-grey pollen forming more or less tessellate pattern, but is totally without shining metallic blue or green. Male genitalia have 2-3 segments and are generally complex, diverse and carry the most diagnostic character for specific identification. The penis is very large and complicated in structure. Inner forceps are larger than outer forceps. The females are usually without ovipositor ^[2].

Materials and Methods

Adult flies were collected from localities falling in the states comprising the North Indian states i.e., Punjab, Jammu & Kashmir, Himachal Pradesh, Uttarakhand and Rajasthan during July 2011 to June, 2012. The collected specimens were killed by putting them in a killing jar charged with ethyl acetate. The dead specimens were pinned using standard entomological pins piercing the right side of the mesothorax. In order to examine the male genitalia, the abdomen was softly detached with the help of fine forceps. The same was put in 10% KOH overnight to soften the chitin and dissolve away muscles and other unwanted parts. The genitalia was dissected from the abdomen and put in ascending grades of alcohol. After dehydration, all the structures were preserved in

the clove oil for clearance purposes until used for identification and photography. Identification of all the specimens was done using the keys given by Senior-White *et al.* ^[4] and Nandi ^[2]. The adult specimens and their genitalia were photographed from different angles with the help of an Image Processing Unit installed in the DRS laboratory of Department of Zoology and Environmental Sciences, Punjabi University, Patiala.

Results

Key to the studied species of genus *Parasarcophaga* Johnston and Tiegss

1. Hind tibia with bristles on anteroventral surface in addition to long villosity.....3 Hind tibia without bristles on anteroventral surface in addition to long villosity.....2
2. Body colours grayish; apical plate of paraphallus slender and sharply pointed at end*sericea* (Walker) Body colours brown; apical plate of paraphallus broad and blunt at end.....*hirtipes* (Wiedmann)
3. Apical plate of paraphallus short and almost blunt at end; inner forceps long and slender.....*miseria* (Walker)

Parasarcophaga sericea (Walker)

(Figs. 1-6)

Sarcophaga sericea Walker, 1852 ^[5], *Ins. Saunders. Dipt.*, 4: 326; Kano and Shinonaga, 1994 ^[6], *Jap. J. sanit. Zool.*, 45: 258.

Sarcophaga aliena Walker, 1856 ^[7], *J. Proc. Linn. Soc. Lond., zool.*, 1: 22.

Sarcophaga brevis Walker, 1864 ^[8], *J. Proc. Linn. Soc. Lond., zool.*, 7: 236.

Sarcophaga knabi Parker, 1917 ^[9], *Proc. U.S. natn. Mus.*, 54: 96.

Sarcophaga (Parasarcophaga) omega Johnston and Tiegss,

1921 ^[10], *Proc. R. Soc. Qd.*, 33(4): 86.

Sarcophaga froggatti Johnston and Tieggs, 1921 ^[10], *Proc. R. Soc. Qd.*, 33(4): 73 (misidentification, not Taylor, 1917).

Sarcophaga omega Johnston and Hardy, 1923 ^[11], *Proc. Linn. Soc. N.S.W.*, 48(2): 116.

Sarcophaga knabi Var. *flavipalpis* Senior-White, 1924 ^[1], *Rec. Indian Mus.*, 26(3): 235.

Parasarcophaga (s.str.) *knabi* Rohdendorf, 1937 ^[12], *Fauna USSR, Dipt.*, 19(1): 202, Fan, 1965, *Synan. Flies China*, 15: 270; Lopes, Kano, Shinonaga and Kurahashi, 1977 ^[13], *Cat. Dipt. Orient. Region*, 3: 571; Nandi, 1991 ^[14], *J. Beng. Nat. Hist. Soc.*, 10(2): 40.

Parasarcophaga (s. str.) *omega* : Lopes, 1959 ^[15], *Studia Ent.*, 2(1): 57.

Parasarcophaga knabi : Park, 1962 ^[16], *Korean J. Zool.*, 5(2) : 39; Kano, Field and Shinonaga, 1967 ^[17], *Fauna Japonica, Sarcophagidae* : 42.

Parasarcophaga (s. str.) *sericea*: Lopes and Kano, 1979 ^[18], *Revta bras. Biol.*, 39(2): 307, Verves, 1986 ^[19], *Cat. Palae. Dipt.*, 12: 171 ; Lopes, 1989 ^[20], *Cat. Dipt. Aust. and Oceanian Regions*, 86: 728; Nandi, 1992 ^[21], *J. Beng. Nat. Hist. Soc.*, 11(2): 38.

Male: Body length 9-14mm.

Head: Width of frons about three-fourths that of one eye; frontal vitta black, its width at narrowest point of frons less than twice that of each parafrontal; parafrontal and parafacial black with silvery to golden pollen; antennae black to dark brown and reaching up to about 0.8 distance to vibrissae; facial ridge light brown with golden pollen; vibrissae long; frontal bristles 10-11, posterior 2 reclinate, anterior 2 below base of antennae, rest cruciate and directed forwards; gena black with short yellowish white hair; post gena black with short hair.

Thorax: Greyish, silvery pollen and with three black longitudinal stripes; *ac* 0+1; *dc* 5+5 (posterior 1 stout); *ia* 1+3; *ps* 1; *h* 3; *ph* 2; *np* 4; *pa* 2; *sa* 3; *st* 1+1+1; *mpl* 6; *hpl* 7; upper part of propleura bare with white pollen; prostigmatic and propleural bristles well developed and accompanied with short hair; pro-and mesothoracic spiracles brown, latter with whitish pollen; apicoscutellar and discoscutellar bristles 1 pair each; lateroscutellar bristles 2 pairs.

Wings: Hyaline with brown veins; R1 bare; R4+5 with row of about 9 short setae located dorsally and extending up to about two-thirds from basal node to r-m; costal spines stout; epaulet black with short spines; basicostal scale light brown; squama white; halter brown.

Legs: Black; fore femur with two rows of long bristles along posterodorsal surface; fore tibia with row of 3 bristles along basal half of anterodorsal surface; mid femur with row of 3-4 short bristles along middle portion of anterolateral surface; mid tibia with 2 long bristles along middle portion of anterodorsal surface; mid femur with pair of rows of long bristles along anterodorsal surface; hind tibia with row of 3 long and few short bristles along anterodorsal surface.

Abdomen

Greyish with silvery checkered pattern; sternite first and second with long but third and fourth with short hair; fifth sternite V-shaped.

Genitalia

First genitalia segment black, grayish pollen and with numerous hair, second shiny black with long hair; inner forceps short, stout and with hair on basal half; outer forceps almost triangular with hair only on posterior end; anterior paramere long, curved and pointed at end; posterior paramere short, pointed and with 2 hair posteriorly; theca almost equal to paraphallus, both are sclerotised; apical plate of paraphallus slender, curved and sharply pointed at end; lateral plate of paraphallus broad and pointed; styli of glans short; ventralia stalked, lobed and its anterior lobe short and slightly curved.

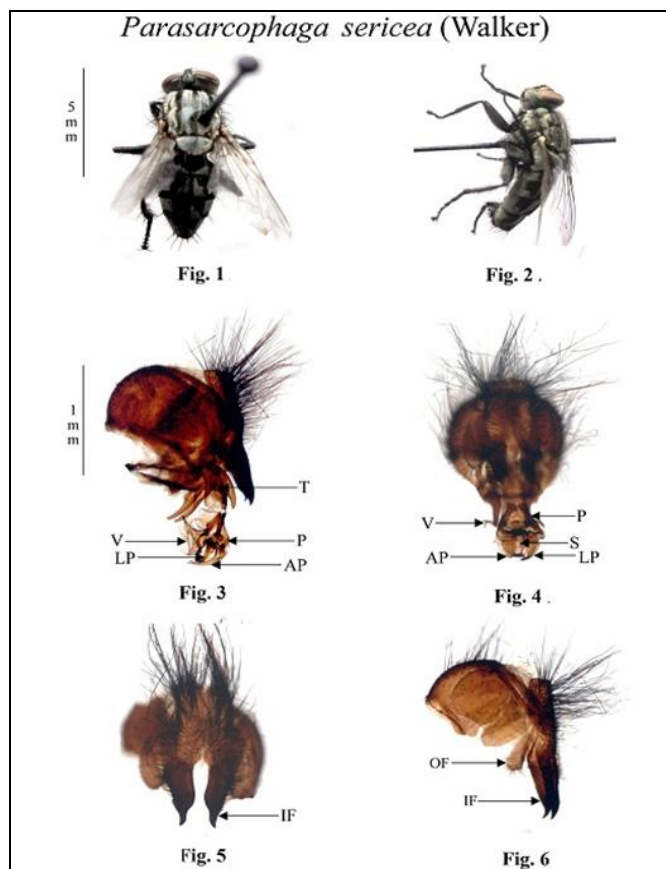


Fig 1: Adult (D.V.); **Fig 2:** Adult (L.V.); **Fig 3:** Male Genitalia (D.V.); **Fig 4:** Male Genitalia (L.V.); **Fig 5:** Forceps (V.V.); **Fig 6:** Forceps (L.V)

Material examined

Punjab: Patiala, 5. vii. 2012 - 2♂♂, Kalsan, 8. vii. 2012 - 4♂♂, Raikot, 10. vii. 2012 - 2♂♂, Himachal Pradesh: Dhanttal, 19. iii. 2000 - 2♂♂, Uttarakhand: Parola, 30. v. 2000 - 2♂♂, Dhanera, 20. iii. 2000 - 2♂♂, Uttrakashi, 1. vi. 2000 - 1♂, Rishikesh, 16. vi. 2000 - 4♂♂, Kalsi, 27. v. 2000 - 1♂, Pauri, 5. vi. 2000 - 1♂, Patahani, 7. vi. 2000 - 4♂♂, Karanpryag, 8. vi. 2000 - 1♂, Jammu and Kashmir: Sri Nagar, 3. vi. 2000 - 4♂♂, Rajasthan: Mt. Abu, 15. iv. 2000 - 1♂, Jaipur, 17. iv. 2000 - 2♂♂, Mandal, 10. vi. 2000 - 1♂.

Distribution

India; Assam, Andhra Pradesh, Bihar, Delhi, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Uttarkhand, Sikkim, Andaman and Nicobar Islands, Chandigarh, Dadra and Nagar Haveli and Pondicherry; Bangladesh; Bhutan; Myanmar; Nepal; Pakistan; Sri Lanka; Australia; Borneo; Caroline Islands; China; East Indies; Guam; Hainan Islands; Indonesia; Irian Jaya; Korea; Malaysia; Mariana Islands; Marshalls Islands; Micronesia; Papua New Guinea; Philippines; Pitcairn Islands; Russia; Singapore; Society Islands; Taiwan; Thailand and Western Samoa.

Remarks

This species is similar to *P. (s. str.) hirtipes* but differ from it by the detailed structure of ventralia and apical plate of paraphallus, the last one is more pointed in this species. Moreover, the ventral membrane between theca and paraphallus is more bulgy here. This species has been reported for the first time from Jammu & Kashmir.

Parasarcophaga hirtipes (Wiedemann)

(Figs. 7-12)

Sarcophaga hirtipes Wiedemann, 1830 ^[22], *Aussereurop. Zweifl. Insekt.*, 2: 361.

Sarcophaga rufipus Wiedmann, 1830 ^[22], *Aussereurop. Zweifl. Insekt.*, 2: 362.

Sarcophaga fulvipalpis Macquart, 1843 ^[23], *Mem. Soc. Sci. Agric. Lille*, 2(3): 255.

Ptilocnema miniaticauda Enderlein, 1828 ^[24], *Arch. Klassif. Phylgen. Ent.*, 1(1): 255.

Sarcophaga dura Curran, 1934 ^[25], *Am. Mus. Nov.*, 727: 12.

Parasarcophaga (s.str.) hirtipes: Rohdendorf, 1937 ^[12], *Fauna USSR, Dipt.*, 19(1): 270; Nandi, 1992 ^[21], *Proc. Zool. Soc., Calcutta*, 45(2): 190.

Pasarsarcophaga (s. str.) africana Rohdendorf, 1963 ^[26], *Stuttg. Beitr. Naturk.*, 124: 15.

Sarcophaga (Parasarcophaga) hirtipes : Zumpt, 1972 ^[27], *Explor. Parc natn. Virunga*, 101: 79.

Male: Body length 9-14mm.

Head: Width of frons about one-third that of one eye; frontal vitta brownish-black; parafrontal and parafacial black with silvery pollen; antennae brown and reaching up to about 0.8 distance to vibrissae; arista long, plumose along basal two

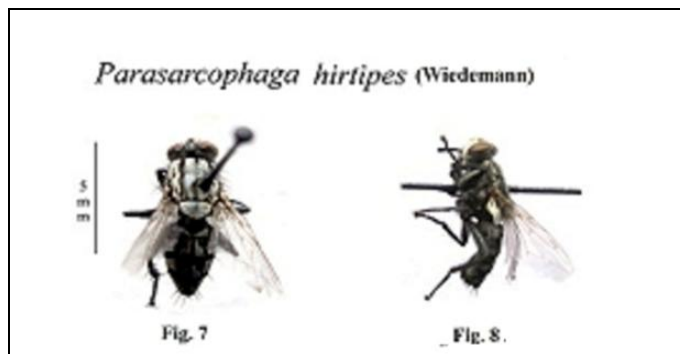
thirds; frontal bristles 9-11, posterior 2 reclinate, anterior 2 below base of antennae and reaching up to about half of second antennal segment, rest cruciate and directed forwards; gena black with golden pollen and short whitish hair; post gena blackish with long whitish hair; ocellar triangle brownish-black with short black hair; outer vertical bristle well developed, inner vertical more developed than outer one, post vertical about one-fourth of inner vertical; ocellar and postocellar bristles short; palpi slender and yellowish; proboscis black.

Thorax: Greyish, mostly brownish silvery pollen and with three black longitudinal stripes; *ac* 0+1; *dc* 5+5; *ia* 1+3; *ps* 1; *h* 4; *ph* 2; *np* 4; *pa* 2; *sa* 3; *st* 1+1+1; *mpl* 7; *hpl* 8-11; upper part of propleura bare with silvery pollen; prostigmatic and propleural bristles well developed and accompanied with short hair and bristles; pro- and mesothoracic spiracles brown; apicocutellar and discocutellar bristles 1 pair each; laterocutellar bristles 2 pairs; 1 pair of short basiscutellar bristles present.

Wings: Hyaline with brown veins; R1 bare; R4+5 with row of 6 short setae located dorsally and extending up to two-thirds distance from basal node to r-m and several short setae along ventral surface of basal node of R4+5; fifth costal segment little shorter than third; costal spines stout; epaulet blackish-brown with short spines; basicostal scale brown; squama white with brownish tinge; halter brown.

Legs: Brownish-black; fore femur with two rows of bristles along posterodorsal surface and a row of bristles along posterior margin of ventral surface; fore tibia with a row of 3 short bristles along basal half of anterodorsal surface; mid femur with a row of 3 bristles along middle portion of anterolateral surface; mid tibia with 2 long bristles on middle portion of anterodorsal surface; hind femur with a pair of rows of bristles along anterodorsal surface; hind tibia with 2 long and a row of short bristles along anterodorsal surface.

Abdomen: Blackish-brown with silvery checkered pattern; median marginal bristles on second and third abdominal tergites absent but each with 1 lateral marginal bristles, fourth with 1 median and 2 lateral marginal bristles, fifth with a row of marginal bristles; sternites first and second with long hair; third and fourth with short hair; fifth sternite Y-shaped with short membranous window bearing spines laterally and hair terminally on arms.



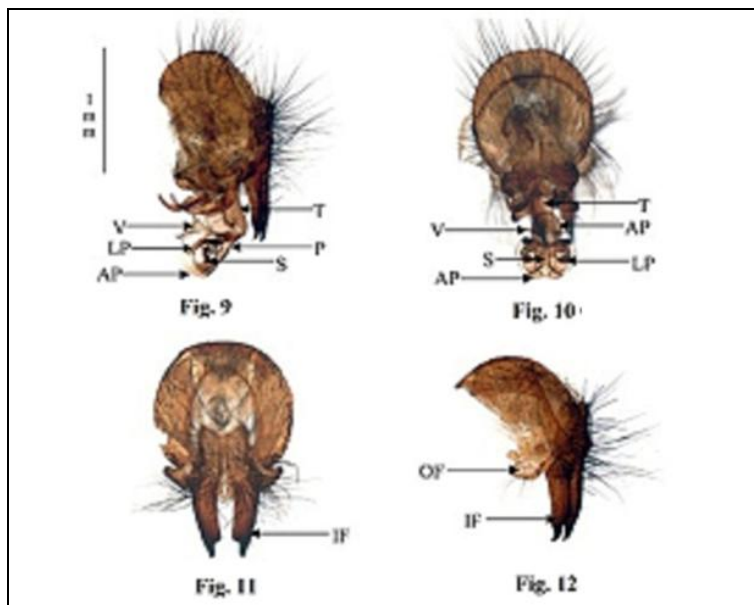


Fig 7: Ault (D.V.); **Fig 8:** Adult (L.V.); **Fig 9:** Male Genitalia (D.V.); **Fig 10:** Male Genitalia (L.V.); **Fig 11:** Forceps (V.V.); **Fig 12:** Forceps (L.V.)

Genitalia

First genital segment reddish-brown with short black hair, second reddish-black or light brown but without marginal bristles; inner forceps long with tuft of long hair along basal half; outer forceps triangular with hair along distal end; anterior paramere long, curved and pointed at end; posterior paramere abruptly curved at end with 2 short hair on its anterior surface apically; apical plate of paraphallus less developed, broad but curved and blunt at end; lateral plate of paraphallus poorly developed and pointed apically; styli of glans very short; ventralia with stalked lobed, anterior lobe deeply curved and moderately developed.

Material examined

Punjab: Patiala, 5.vii.2012-1♂, Kalsan, 8.vii.2012-2♂, Raikot, 10.vii.2012-2♂, Himachal Pradesh: Dhamtal, 19.iii.2000-1♂, Dharmshala, 21.iii.2000-2♂, Kalsi, 27.v.2000-1♂, Karanpryag, 8.vi.2000-2♂, Uttarakhand:- Parola, 30. v. 2000 - 3♂♂, Uttarakashi, 1. vi. 2000 - 1♂, Rajasthan: Jaipur, 17.iv.2000-3♂, Mt.Abu, 15.iv.2000-1♂.

Distribution

India; Arunachal Pradesh, Bihar, Delhi, Gujarat, Karnataka, Kerala, Madhya Pradesh, Himachal Pradesh, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarkhand, West Bengal, Andaman Nicobar; Bangladesh; Pakistan; Afghanistan; Algeria; Angola; Arabia; Azerbaijan; Botswana; Bulgaria; China; Egypt; Gambia; Guinea; Iran; Iraq; Israel; Jordan; Kazakhstan; Kenya; Kyrgyzstan; Lebanon; Liberia; Morocco; Namibia; Russia; Saudi Arabia; Senegal; South Africa; Sudan; Syria; Tajikistan; Tanzania; Turkey; Turkmenistan; Uganda; Uzbekistan; Zaire; Zambia and Zimbabwe.

Remarks

This species is similar to *Parasarcophaga (s. str.) sericea* but differs from it by the structure of lateral plate of paraphallus.

Moreover, the anterior paramere is less thickened in this species.

Parasarcophaga misera (Walker)

(Figs. 13-18)

Sarcophaga misera Walker, 1849 ^[28], *List. Dipt. Br. Mus.*, 4: 829; Kano and Shinonaga, 1994, *Jap. J. Sanit. zool.*, 45: 257.

Sarcophaga innotata Walker, 1864 ^[29], *J. Proc. Linn. Soc. Lond. Zool.*, 7: 214.

Sarcophaga orchidea Boettcher, 1913 ^[30], *Annls hist. nat- Mus. Natn. Hung.*, 11: 375.

Sarcophaga gamma Johnston and Tiegs, 1921 ^[10], *Proc. R. Soc. Qd.*, 33(4): 60.

Sarcophaga brunneopalpis Johnston and Tiegs, 1922 ^[31], *Proc. R. Soc. Qd.*, 34: 184.

Sarcophaga hirtipes var. *orchidea* Senior-White, 1924 ^[1], *Rec. Indian, Mus.*, 26 (3): 239; Senior- White, Aubertin and Smart, 1940 ^[4], *Fauna Br. India, Dipt.*, 6: 244.

Sarcophaga noumea Curran, 1929 ^[31], *Am. Mus. Nov.*, 375: 11.

Parasarcophaga orchidea: Kano, Field and Shinonaga, 1967 ^[17], *Fauna japonica, Sarcophagidae*:44.

Parasarcophaga (s.str.) misera: Lopes and Kano, 1979 ^[18], *Revta bras. Biol.*, 39(2): 309; Nandi, 1992 ^[21], *J. Beng. Nat. Hist. soc.*, 11(2): 38.

Male: Body length 9-14mm.

Head: Width of frons about half that of one eye; frontal vita black; parafrontal and parafacial black with silvery pollen; antennae dark brown and reaching up to about 0.7 distance to vibrissae; arista long, plumose along basal three-fifths; vibrissae long, crossed, distance between vibrissae less than one parafacial width; frontal bristles 12, posterior 3 reclinate, anterior 3 below base of antennae and reaching up to about half of second antennal segment, rest cruciate and directed forwards; gena black with silvery pollen and hair; ocellar

triangle black with long black hair; palpi slender and brown; proboscis black.

Thorax: Grey, silvery pollen and with three black longitudinal stripes; *ac* 0+1; *dc* 5+5; *ia* 1+3; *ps* 1; *h* 3, *ph* 2, *np* 4, *pa* 2; *sa* 4; *mpl* 6; *hpl* 8; upper part of propleura bare with silvery pollen; prostigmatic and propleural bristles well developed and accompanied with short hair; prothoracic spiracles with dense brown pile; mesothoracic spiracle chocolate coloured; apicoscutellar and discoscutellar bristles 1 pair each; lateroscutellar bristles 2 pairs.

Wings: Hyaline with brown veins; R1 bare; R4+5 with 2 short setae located dorsally and extending up to about one-third from basal node to r-m and several short setae along ventral surface of basal node of R4+5; fifth costal segment shorter

than third; former with short spines along basal half of its anterior margin; costal spines stout; basicostal scale light brown; epaulet black with short spines; squama whitish; halter brown.

Legs: Black; fore femur with two rows of bristles along posterodorsal surface and row of bristles along posterior margin of ventral surface; fore tibia with row of 3 bristles along basal half of anterodorsal surface; mid femur with row of 3-4 short bristles along middle portion of anterolateral surface; mid tibia with 2 bristles on middle portion of anterolateral surface; hind femur with pair of bristles along anterodorsal surface; hind tibia with 2 long and a row of short bristles along anterodorsal surface and numerous long hair along posterior margin of ventral surface at about two-thirds distance from distal end.

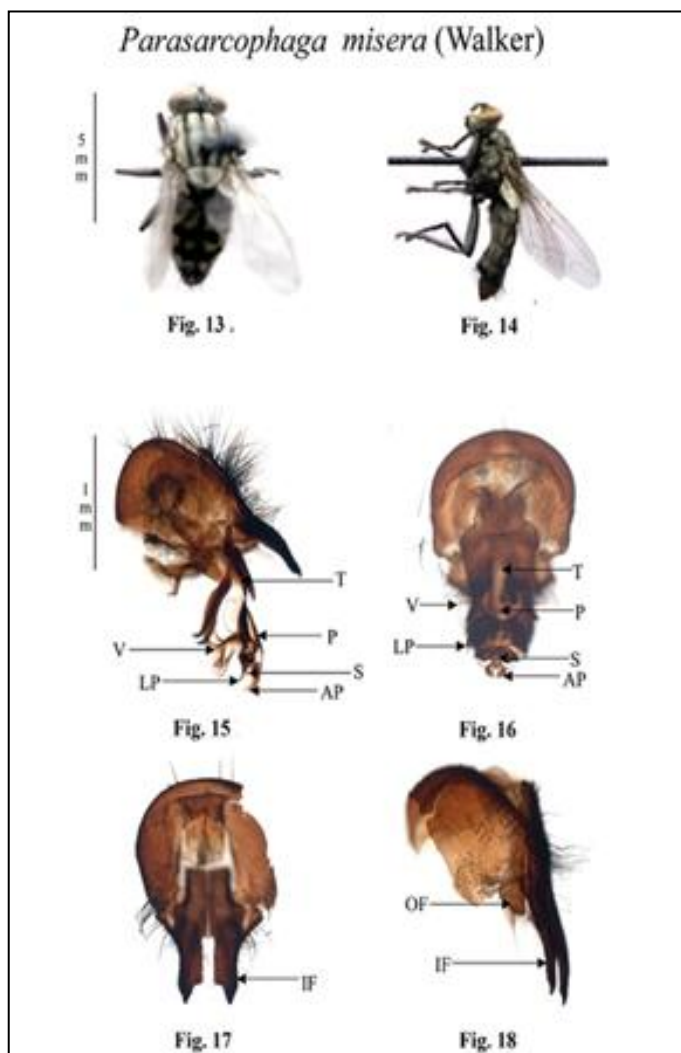


Fig 13: Adult (D.V.); **Fig 14:** Adult (L.V.); **Fig 15:** Male Genitalia (D.V.); **Fig 16:** Male Genitalia (L.V.); **Fig 17:** Forceps (V.V); **Fig 18:** Forceps (L.V.)

Abdomen

Black with silvery checkered pattern; median marginal bristles on second and third abdominal tergites absent but each with well-developed lateral marginal bristles, fourth with a pair of well-developed median and several pairs of lateral marginal

bristles, fifth with a row of 16-18 marginal bristles; sternite first and second with dense erect hair, third and fourth with short hair; fifth sternite Y-shaped with wide window and divergent arms with many short spines laterally and few hair terminally.

Genitalia

First genital segment brown with short hair, second blackish brown, with short hair but both without median marginal bristles; penis elongated; inner forceps long, slender, and with tuft of long hair along basal half; outer forceps triangular with short hair only on distal end; anterior paramere long, pointed, curved at end but without hair; posterior paramere short, blunt at end and with 1-2 short hair terminally; theca shorter than paraphallus, both sclerotised; apical plate of paraphallus short and almost blunt at end; lateral plate of paraphallus short and pointed; styli of glans short; ventralia with stalked lobes, anterior lobe well developed and not so curved, posterior lobe short.

Material examined

Punjab: Patiala, 5.vii.2012-4♂♂, Kalsan, 8.vii.2012-2♂, Raikot, 10.vii.2012-2♂, Himachal Pradesh: Dhamtal, 19.iii.2000-4♂♂, Uttarkhand: Parola, 30. v. 2000 - 1♂, Uttarakashi, 1. vi. 2000 - 4♂♂, Dhanera, 20. iii. 2000 - 2♂♂, Rajasthan: Mt.Abu, 15.iv.2000-1♂, Jammu & Kashmir: - Sri Nagar, 3. vi. 2000 - 2♂♂.

Distribution

India; Arunachal Pradesh, Assam, Andhra Pradesh, Bihar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarkhand and West Bengal. Union territory of Andaman and Nicobar Islands, Chandigarh, Dadra and Nagar Haveli, Lakshadweep, Pondicherry; Bangladesh; Bhutan; Myanmar; Nepal; Pakistan; Sri Lanka; Afghanistan; Australia; Bonin Islands; Borneo; Caroline Islands; China; Hainan Island; Indonesia; Iran; Japan; Kiribati; Korea; Malaysia; Mariana Islands; Marshall Islands; New Caledonia, New Guinea; New Hebrides; Papua New Guinea; Philippines; Samoa; Singapore; South Korea; Sumatra; Taiwan and Thailand.

Remarks

This species is similar to *Parasarcophaga (s.str.) albiceps* and *Parasarcophaga (s.str.) sericea* but can be distinguished from them by the structure of ventralia. Moreover, the inner forceps in this species is more slender and ventral portion between theca and paraphallus is not as bulgy as in other species.

List of Abbreviations Used

AP: Apical plate, DV: Dorsal View, IP: Inner Forceps, LP: Lateral Plate, LV: Lateral View, OP: Outer Forceps, P: Paraphallus, S: Styli of Glans, T: Theca, V: Ventralia, VV: Vertical View

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