International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

IJFBS International Journal of Fauna And Biological Studies

ISSN 2347-2677
IJFBS 2017; 4(4): 155-161
Received: 21-05-2017
Accepted: 22-06-2017

Manish Sharma
Assistant Professor in Zoology,
PG Department of Agriculture
GSSDGS Khalsa College Patiala,
Punjab, India

Palwinder Singh
Department of Zoology and
Environmental Sciences
Punjabi University Patiala-
147001, Punjab, India

Devinder Singh
Department of Zoology and
Environmental Sciences
Punjabi University Patiala-
147001, Punjab, India

Correspondence
Manish Sharma
Assistant Professor in Zoology,
PG Department of Agriculture
GSSDGS Khalsa College Patiala,
Punjab, India

Morphological studies on *Parasarcophaga albiceps*, *Parasarcophaga macroauriculata* and *Parasarcophaga ruficornis* (Diptera: Sarcophagidae) of Indian origin

Manish Sharma, Palwinder Singh and Devinder Singh

Abstract
The male genitalia of three species *Parasarcophaga albiceps* (Meigen), *Parasarcophaga macroauriculata* (Ho) and *Parasarcophaga ruficornis* (Fabricius) have been studied in detail. The present work includes the descriptions and detailed illustrations of external male genitalic structures which have not been published so far these three species. A key to the studied species is also given.

Keywords: Diptera, Key, Male Genitalia, Oestroidea, *Parasarcophaga*, Sarcophagidae

Introduction
The Sarcophagidae is globally distributed family consisting of about 3000 species under 173 genera (Pape *et al.*, 2011) [34]. Sarcophagidae is one of six recognized families in the superfamily Oestroidea, which is generally regarded as sister to the superfamily Muscoidea (McAlpine, 1989, Yeates *et al*., 2007) [21, 51]. A full revision of the family was given by Aldrich (1916) [1], although more restricted revisionary works have been published recently focusing on particular subgroups and/or genera (Pape, 1994; Dahlem and Downes, 1996) [31, 6]. A recent and authoritative list of names and synonymies has been given by Pape (1996) [32]. Monophyly of the family Sarcophagidae appears to have a solid morphological basis, as all sarcophagids possess a unique bilobed uterus (Pape, 1996) [32].
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 (Chakraborty *et al*. 2017) [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. Colour of these flies is generally grayish to black with silvery to golden or yellowish pollen. Eyes are medium or large but without hair, dichoptic and frons is narrower in males than females. Third antennal segment is larger and arista is usually long and plumose along basal half but sometimes bare or pubescent. Palpi are black or yellowish. The thorax is mostly with three dark longitudinal stripes or sometimes entirely grey or black or blackish but without long golden hair. Presutural acrostichal bristles are absent or feebly developed or sometimes moderately developed. Wings are generally hyaline or infuscated along anterior margin. Abdomen may have silvery-grey pollen forming more or less tessellate pattern, but is totally without shinning metallic blue or green. Male genitalia has 2-3 segments and is 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. Most of the flies are larviparous but they sometimes deposit embryonated eggs. (Nandi, 2002) [30].

Materials and Methods
Collections and Preservation
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. Extensive and intensive survey work was planned keeping in view different seasons of the year. Varied habitats like forests, bushes, flowers, heaps of garbage, rotting fruits and vegetables, decaying animal remains, excreta of animals etc. were visited to collect the flesh flies. 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. 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*. (1940) [41] and Nandi (2002) [30]. The arrangement of various bristles present on the thorax is important taxonomically. The photographs of adult specimens were taken with the help of an Image Processing Unit installed in the DRS laboratory of Department of Zoology and Environmental Sciences, Punjabi University, Patiala.

Key to studied genera

1. Third abdominal tergite normally without long bristles in middle of posterior margin; apical plate of paraphallus always small….....*Parasarcophaga*

Genus *Parasarcophaga* Johnston and Tiegs, 1921 [10]

Third antennal segment two to three times that of the second; first genital segment of male usually without marginal bristles; third abdominal tergite without long bristles; anal tergite sometimes red; paraphallus comparatively short and heavily scelotised; apical plate of paraphallus well developed, styli of glans cueved, stout, slender and never closely adjacent to apical plate; basal part of styli of glans coiled; lateral plate of paraphalus well developed, single but without process; ventralia always present with two pairs of lobes

Key to studied subgenera

1. Lateral plate of paraphallus in form of lamellate hook-shaped process…….……..……..2
   Lateral plate of paraphallus in form of an unpaired pedunculate process…….....*Parasarcophaga*
2. Lateral plate of paraphallus rudimentary; posterior part of penis membranous owing to division along median line of basal part of paraphallus; lateral process of apical part of paraphallus with sharp teeth extending forward…….*Liopygia*

Subgenus *Parasarcophaga* Johnston and Tiegs, 1921 [10]

Penis with long stalked ventralia which is large and flower-like; apical plate of paraphallus with almost no median section and more or less transparent or slightly sclerotised and cleft; styli of glans short or reduced; lateral plate of paraphallus large, unpaired, with short stalked process and split at the end; R1 bare; upper part of propleura bare; abdomen without chess board pattern; genital segment without bristles.

Key to studied species

1. Middle part of inner forceps without protuberance but with spines at inner surface of subapical end…….……..…..*albiceps* (Meigen)
   Middle part of inner forceps with protuberance and spines at inner surface of subapical end……..…...*macroauriculata* (Ho)

***Parasarcophaga (s. str.) albiceps* (Meigen)**

(Figs. 42-47)

Sarcophaga albiceps Meign, 1826, *Syst. Beschr. Zweilf. Insekt*., 5: 22, Kano and Shinonaga, 1994 [12], *Jap. J. sanit. Zool*., 45: 256.

Sarcophaga privigna Rondani, 1860, *Atti Soc. ital. Sci. nat*., 3: 387.

Sarcophaga cyathisans Pandelle, 1896, *Revta Ent.,* 15: 191.

Sarcophaga pauciseta Karmer, 1905, *Z. syst. Hymenopt. Dipterol*., 5: 331.

Thyrsocnema albiceps: Enderlien, 1928, *Arch. klassif. phyloden Ent.,* 1(1): 43.

Sarcophaga hypopygium Malloch, 1934, *Mem. Mus. Nat. Hist. Belg*., 4(10): 22.

Sarcophaga zethus Curran, 1936, *Proc. Calif. Acad. Sci.,* (4) 22: 60.

Parasarcophaga albiceps: Rohdendorf, 1937, *Fauna USSR, Dipt.,* 19(1): 199; Darber-Monko, 1973, *Fragm. Faun. Warsz.,* 19(7): 200; Kano, Field and Shinonaga, 1967, *Fauna Japonica,* Sarcophagidae: 39; Pape, 1987, Notul. Ent., 67: 45.

Parasarcophaga (s. str.) albiceps: Nandi, 1992, *J. Beng. nat. Hist. Soc.,* 11(2): 38.

Male: Body length 11-17mm.

Head: Width of frons about three-fifths that of one eye; frontal vitta black, its width at narrowest point of frons about twice that of each parafrontal; parafrontal and parafacial black with silvery pollen; antennae dark brown and reaching up to about 0.8x distance to vibrissae; facial ridge blackish-brown, silvery pollen and with spines along basal half; vibrissae long; frontal bristles 12, posterior 2 reclinate, anterior 2 below base of antennae, rest cruciate and directed forwards; gena black with silvery pollen and with numerous black hair; post gena black with whitish pollen; palpi brown; proboscis black.

Thorax: Grey, silvery pollen and with three black longitudinal stripes; *ac* 0+1; *dc* 5+5 (posterior 1 *dc* stout); *ia* 1+3; *ps* 1; *h* 3; *ph* 2; *np* 4; *pa* 2; *sa* 4; *st* 1+1+1; *mpl* 6; *hpl* 8; upper part of propleura bare; prostigmatic and propleural bristles well developed and accompanied with short hair; pro- and mesothoracic spiracle brown; apicoscutellar and discoscutellar bristles 1 pair each; lateroscutellar bristles 3 pairs of which basal 1 weak.

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

Legs: Black; fore femur with two rows of long bristles along posterodorsal surface; fore tibia with row of 2-3 short bristles along basal half of anterodorsal surface; mid femur with row of 3 bristles along middle portion of anterolateral surface; mid tibia with 1 long and a row of short bristles along anterodorsal surface; hind femur with a pair of rows of long bristles along anterodorsal surface; hind tibia with 2 bristles on middle portion of posterodorsal surface.

Abdomen: Black with silvery grey checkered pattern; median marginal bristles on second and third abdominal tergites absent but second with 2 and third with 2-3 well developed lateral marginal bristles, fourth with a pair of stout and several pairs of ordinary lateral marginal bristles, fifth with a row of 18 marginal bristles; sternite first and second with long hair, third and fourth with short sparse hair but without differentiated bristles; fifth sternite Y-shaped with stout spines laterally and long hair terminally on arms.

Genitalia: First genital segment blackish with short hair, second black with numerous black hair but without marginal bristles; inner forceps stout, elongated, without protuberance and spines at inner surface of sub-apical part but with tufts of long hair along basal half; outer forceps elongated, somewhat kidney-shaped with hair along distal half; anterior paramere long and curved in middle; posterior paramere flat in middle with several hair at apical part; theca and paraphallus long, curved and pointed at end; lateral plate of paraphallus moderately long and pointed; styli of glans short; ventralia with long stalked wide lobe and anterior portion deeply curved.

Material Examined: Uttarakhand: Parola, 30. v. 2000 - 4♂♂, Dhanera, 20. iii. 2000 - 2♂♂, Uttrakashi, 1. vi. 2000 - 2♂♂, Rishikesh, 16. vi. 2000 - 1♂, Patahani, 7. vi. 2000 - 1♂, Chipalghat 7. vi. 2000 - 1♂, Jammu and Kashmir: Sri Nagar, 3. vi. 2000 - 3♂♂.

Distribution: India; Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Goa, Gujarat, Haryana, Jammu & Kashmir, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttrakhand, West Bengal, Andaman Nicobar, Chandigarh, Daman and Diu, Dadra and Nagar Haveli, Lakshadweep and Pondicherry; Bangladesh; Bhutan; Myanmar; Nepal; Pakistan; Sri Lanka; Albania; Armenia; Australia; Austria; Azerbaijan; Belgium; Borneo; Bulgaria; Byelorussia, Chech Republic; China; Finland; France; Germany; Grat Britain; Greece; Gruzia; Hawaiian Islands; Hungary; Indonesia; Ireland; Israel; Italy; Japan; Kazakhstan; Korea; Latvia; Malaysia; Moldova; New Britain; New Guinea; Philippines; Poland; Romania; Russia; Servia; Singapore; Slovakia; Solomon Islands; Sweden; Switzerland; Taiwan; Thailand; Turkey; Ukraine and United Kingdom.

Remarks: This species is similar to *P. (s. str.) sericea* and *P. (s. str.) hirtipes* by the structure of apical plate of para[hallus but may be distinguish from *sericea* by detailed structure of ventralia and from *hirtipes* by elongated styli of glans. Moreover, the inner forceps is more slender here. This species may be distinguished from *P. (s. str.) macroauriculata* by the structure of inner forceps and the absence of spines on it

***Parasacrophaga (s. str.) macroauriculata* (Ho)**
(Figs. 48-53)
Sacrophaga macroauriculata Ho, 1932, *Bull.Fan meml Inst. Biol*., **3**(1): 347; Kano and Shinonaga, 1994 [12], *Jap.J. sanit. Zool*., **45**: 259
Parasacrophaga (s.str.) macroauriculata: Rohdendorf, 1937, *Funna USSR, Dipt*., **19** (1): 202; Nandi, 1990, *J. Beng. nat. Hist. Soc*., **9** (1): 20
Parasacrophaga macroauriculata: Kano, Field and Shinonaga, 1967, *Fauna Japonica Sarcophagidae:* 45.

Male: Body length 8-13 mm.

Head: Width of frons about one fifths that of one eye; frontal vita black, its width at narrowest point of frons about twice that of parafrontal; parafrontal and parafacial black with silvery pollen; antennae blackish-brown and reaching up to about 0.8x distance of vibrissae; arista long, plumose along basal two–thirds ; facial ridge blackish–brown with silvery pollen ; vibrissae long, crossed, distance between vibrissae greater than one parafacial width; frontal bristles 12-13, posterior 2 reclinate, anterior 3 below base of antennae and reaching up to about half of the second antennal segment, rest cruciate and directed forwards ; gena black, silvery pollen and with short hair; post gena blackish with whitish hair; palpi brown and slender ; proboscis dark brown.

Thorax: Grey, silvery pollen and with three black longitudinal stripes; *ac* 0+1 ; *dc* 5+5 (posterior 1 dc stout); *ia* 1+3; *ps* 1; *ph* 3; *np* 4 ; *pa* 2; *sa* 3 ;*st* 1+1+1; *mpl* 6-7 ; *hpl* 8-9; upper part of propleura bare, black with silvery pollen ; prostigmatic and propleural bristles well developed and accompanied with short hair ; pro- and mesothoracic spiracles brown; apicoscutellar and discoscutellar bristles 1 pair each; lateroscutellar bristles 3 pairs.

Wings: Hyaline with brown veins; R1 bare ; R4+5 with a row of short setae located dorsally and extending up to more than half from basal node to r- m; costal spines not stout; epaulet black with short spines; basicostal scale brown ; squama white; halter brown.

Legs: Black; fore femur with two rows of bristles along posteror margin of ventral surface; fore tibia with a row of 3-4 short bristles along basal half of anterodorsal surface; mid femur with a row of 3 short bristles along middle portion of anterolateral surface; mid tibia with 1 long and a row of short bristles along anterodorsal surface and 2 long bristles on the middle portion of posterolateral surface; hind femur with a pair of rows of long bristles along anteroventral surface; hind tibia with row of 3-4 short bristles along anterolateral surface.

Abdomen: Black with silvery grey checked pattern; median marginal bristles on second and third abdominal tergites absent but second with 2 and third with 3 lateral marginal bristles, forth with pair of median and 4 -5 lateral marginal bristles, fifth with row of 18 marginal bristles ; sternites first to forth with long hair but without differentiated bristles ; fifth sternites Y- shaped with membranous window and stout spines laterally and long hair terminally on arms.

Genitalia: First and second genital segments brownish with short hair; inner forceps moderately broad, stout, slightly curved at end, with large protuberance at mid posterior portion and short hair on outer surface and few spines on inner surface at sub apical end; outer forceps elongated with few hair ; anterior paramere sickle–shaped and curved at end; posterior paramere elongated with few hair ; theca shorter than paraphallus, both sclerotised; apical plate of paraphallus long, sharply pointed, curved at end and with 2 slight knob-like projections at outer sub terminal end ; lateral plate of paraphallus long and pointed ; styli of glans short; ventralia stalked, lobed and anterior portion more developed and slightly curved.

Material Examined: Uttarakhand: Mandal, 10. vi. 2000 - 2♂♂.

Distribution: India; Manipur, Meghalaya, Nagaland, Sikkim, Uttar Pradesh, Uttrakhand and West Bengal; Nepal; Pakistan; China; Japan; Korea and Russia.

Remarks: This species is similar to *Parasarcophaga (s. str.) albiceps* but may be differentiated from it by the structure of ventralia and apical portion of paraphallus. Moreover, the inner forceps is with a large protuberance and spines at its inner surface of sub apical end and short hair on outer surface.

Subgenus *Liopygia* Enderlein, 1928 [7]

Lateral plate of paraphallus in the form of hook-shaped slender paired processes and relatively short; ventralia short and its proximal end knob like; styli of glans not stout; apical plate of paraphallus well developed and in most cases terminating in a pair of lateral processes; posterior end of praphallus membranous; inner forceps without spines.

***Parasarcophaga (Liopygia) ruficornis* (Fabricus)**

(Figs. 54-59)

Musca ruficornis Fabricus, 1794, *Ent. Syst.,* 4: 314.

Sarcophaga ruficornis: Macquart, 1851, *Mem. Soc. Sci. Agric. Lille.,* 206 (preoccupied, Fabricus, 1794).

Liopygia ruficornis: Enderlein, 1928 [7], *Arch. klassif. phylogen. Ent.,* 1(1): 41.

Liopygia friederichsiana Enderlein, 1928 [7], *Arch. klassif. phylogen. Ent.,* 1(1): 42.

Sarcophaga ruficornis: Wiedmann, 1830, *Aussereurop. zweifl. Insekt.,* 2: 361; Kano and Shinonaga, 1994 [12], *Jap. J. sanit. zool.,* 45: 261.

Sarcophaga (Parasarcophaga) ruficornis: Hardy, 1943, *Proc. Linn. Soc.* N.S.W., 68: 29.

Parasarcophaga ruficornis: Lopes, 1945, *Revta bras. Biol.,* 5(3): 401; Kano, Field and Shinonaga, 1967, *Fauna Japonica*, Sarcophagidae: 74.

Sarcophaga muspratti Zumpt, 1950, *Proc. R. ent. Soc. Lond.,* (B) 19: 185.

Parasarcophaga (Jantia) ruficornis: Lopes, 1958, *Ins. Micro.,* 13(2): 48.

Parasarcophaga (Liopygia) ruficornis: Rohdendorf, 1963, *Stuttg. Beitr. Naturk*., 124: 9; Nandi, 1992, *J.Beng. nat. Hist. Soc.,* 11(2): 36.

Male: Body length 7-13mm.

Head: Width of frons about two-fifths that of one eye; frontal vitta black, slightly diverging below and its width at narrowest point of frons more than twice that of each parafrontal; parafrontal and parafacial black with golden pollen; antennae orange and reaching up to about 0.8x distance to vibrissae; facial ridge light brown and bare; vibrissae long; frontal bristles 12, posterior 2 reclinate, anterior 3 below base of antennae, rest cruciate and directed forwards; gena
black with silvery pollen and yellowish hair; post gena black with grayish hair; palpi slender and black; proboscis short and brownish-black.

Thorax: Black, silvery pollen and with three black longitudinal stripes; *ac* 0+1; *dc* 6+4-5 (posterior 2 *dc* well developed); *ia* 1+3; *ps* 1; *h* 3; *ph* 2; *np* 3; *pa* 2; *sa* 3; *st* 1+1+1; *mpl* 4; *hpl* 9; upper part of propleura bare, black and with white pollen; prostigmatic and propleural bristles well developed and accompanied with short hair; pro-and mesothoracic spiracle brown; apicoscutellar and discoscutellar bristles short, 1 pair each; lateroscutellar bristles 2 pairs.

Wings: Hyaline with brown veins; R1 bare; R4+5 with row of about 10 short setae located dorsally and extending more than half from basal node to r-m; costal spines not stout; epaulet black with 2 long and many short black hair; basicostal scale light brown; squama whitish; halter brown.

Legs: Black; fore femur with two rows of long bristles along posterodorsal surface; fore tibia with row of 2-3 bristles along basal half of anterodorsal surface; mid femur with row of 3 bristles along middle portion of anterolateral surface; mid tibia with 1 bristle on anterodorsal surface; hind femur with pair of rows of long bristles along anterodorsal surface; hind tibia with row of 3 long bristles along anterodorsal surface.

Abdomen: Black with silvery checkered pattern; median marginal bristles on second and third abdominal tergites absent but each with pair of well-developed lateral marginal bristles, fourth with pair of median and 3 pairs of lateral marginal bristles, fifth with row of 20 marginal bristles; sternite first to fourth with black hair but without any differentiated bristles; fifth sternite V-shaped with wide window and spines laterally and long hair terminally on arms.

Genitalia: First genital segment blackish with 3 pairs of marginal bristles, second with black hair but without marginal bristles; penis with membranous bulbous portion in between theca and paraphallus; inner forceps densely covered with long hair and ending in acute point at end; outer forceps somewhat oval; anterior paramere bent, pointed at end and with single hair along posterior margin; posterior paramere curved, pointed at end; theca shorter than paraphallus, both sclerotised; apical plate of paraphallus not sclerotised but composed of two plates, one of which
with backwardly projecting spines; lateral plate of paraphallus small and serrated anteriorly; styli of glans well developed, divided into pointed membranous portion and another having rosette-like structure; ventralia bulbous, much sclerotised at end and with long stalk and sub-basal spinous portion.

Material examined: Uttarakhand: Uttarkashi, 1. vi. 2000 - 1♂.

Distribution: India; Arunachal Pradesh, Assam, Bihar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Madhya Pradesh, Nagaland, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarkhand and West Bengal, Andaman and Nicobar Islands, Dadra and Nagar Haveli, Pondicherry and Lakshadweep; Bangladesh; Bhutan; Nepal; Pakistan; Sri Lanka; Borneo; Botswana; Brazil; Canada; Guam; Hainan Islands; Hawaiian Islands; Japan; Korea; Madagascar; Malaysia; Mariana Islands; Moluccas Islands; Myanmar; Nigeria; Panama; Papua New Guinea; Philippines; Saudi Arabia; Singapore; Socotra Islands; South Africa; Taiwan; Thailand; Uganda; USA; Western Samoa and Zaire.

Remarks: This species is characterized by having bulbous ventralia, elongated apical plate of paraphallus with backwardly projecting spines and a peculiar type of styli of glans.

Figures:

***Parasarcophaga (s. str.) albiceps* (Meigen)**

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.)

***Parasacrophaga (s. str.) macroauriculata* (Ho)**

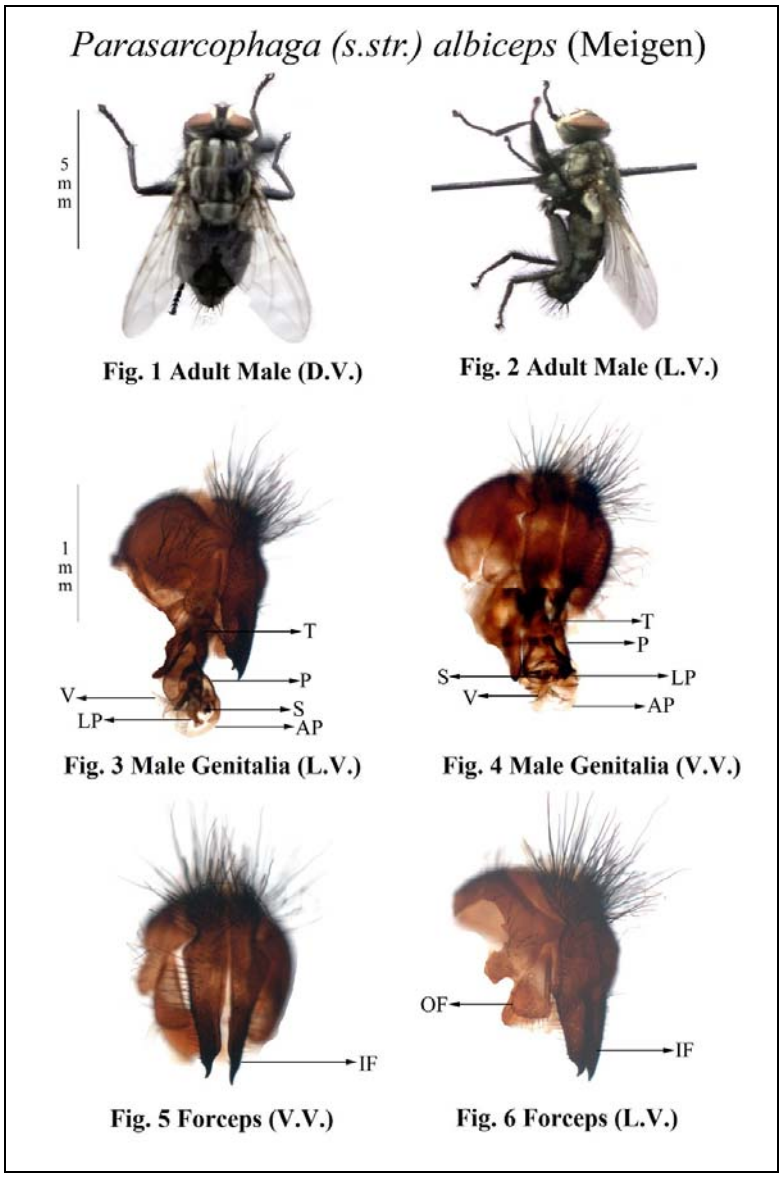
Fig.7-Adult (D.V.); Fig. 8-Adult (L.V.); Fig. 9-Male Genitalia (D.V.); Fig. 10- Male Genitalia (L.V.); Fig. 11-Forceps (V.V.); Fig. 12-Forceps (L.V.)

***Parasarcophaga (Liopygia) ruficornis* (Fabricus)**

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.)

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



Parasarcophaga (s.str.) macroauriculata (Ho)

Fig. 7 Adult Male (D.V.)

Fig. 8 Adult Male (L.V.)

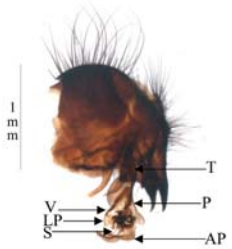


Fig.9 Male Genitalia (L.V.)

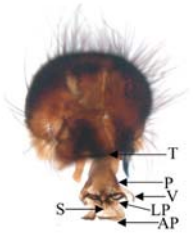


Fig.10 Male Genitalia (V.V.)

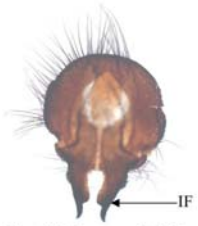


Fig. 11 Forceps (V.V.)

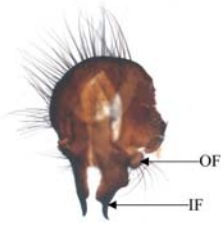


Fig. 12 Forceps (L.V.)

Parasarcophaga (Liopygia) ruficornis (Fabricius)

Fig.13 Adult Male (D.V.)

Fig. 14 Adult Male (L.V.)

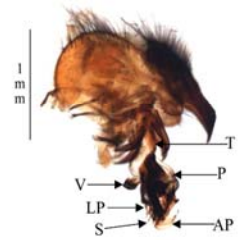


Fig. 15 Male Genitalia (L.V.)

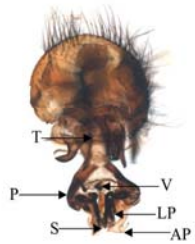


Fig. 16 Male Genitalia (V.V.)

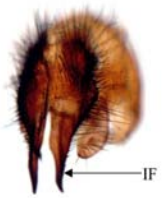


Fig. 17 Forceps (V.V.)

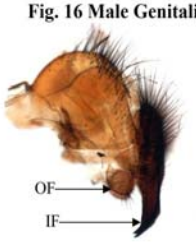


Fig. 18 Forceps (L.V.)

References

1. Aldrich JM. *Sarcophaga*and allies in North America. The Thomas Say Foundation. La Fayette. 1916; 1:1-301.
2. Boettcher G. H. Sauter's Formosa-Ausbeutc. Einige neue Sarcophaga-Arten. Annls hist-nat. Mus. natn. hung. 1913; 11:374-381.
3. Chakraborty A, Hora G, Parui P, Saha GK, Banerjee D. A biosystematic species inventory of Indian Sarcophagidae (Insecta: Diptera: Sarcophagidae), J. Entomol. Zoo. Stud., 2017; 5(1):465-473.
4. Curran CH. Diptera collected by Prof. and Mrs. Cockerell in New Caledonia and Fiji Islands. Am. Mus. Nov., 1929; 375:1-15.
5. Curran CH. The Sarcophaginae of the American Museum, Congo Expedition (Diptera). Am. Mus. Nov. 1934a; 727:1-31.
6. Dahlem AG, Downer (Jr.) WL. (Jr.) Revision of the genus *Boettcheria* in America North of Mexico (Diptera: Sarcophagidae). *Insecta Mundi*. 1996; 10:1-4.
7. Enderlein G. Sarcophagiden-Studicn 1. Klassifikation dcr Sarcophagiden. Arch. Klassitf. phylogen. Ent. 1928a; 1(1):1-56.
8. Fan Zd. Key to species of the common synanthropic flies of China, Peking: 1965; XV+I-330 (In Chinese).
9. Johnston TH, Hardy GH. A revision of the Australian Diptera belonging to the genus *Sarcophaga. Proc*. Linn. Soc. N. S. W. 1923; 48(2):94-129.
10. Johnston TH, Tiegs CW. New and little-known sarcophagid flies from South Queensland. Proc. R. Soc. Qd. 1921; 33(4):46-90.
11. Johnston TH, Tiegs CW. New and little known Australian sarcophagid flies. Proc. R. Soc. Qd., 1922c; 34:81-190.
12. Kano R. In: Kano R, Shinonaga S. Studies on the sarcophagid flies from Nepal (Diptera: Sarcophagidae). Jap. J. sanit. Zool. 1994; 45:253-275.
13. Kano R, Field O, Shinonaga S. Sarcophagidae (Insecta: Diptera). In: Fauna Japonica. 1967; 7:1-168.
14. Kano R, Field O, Shinonaga S. Sarcophagidae (Insecta: Diptera). *In*: *Fauna Japonica*. 1967; 7:1-168.
15. Lopes H, de Souza, Kano R. On the types of some Oriental species of Sarcophagidae (Diptera), described by Francis Walker. Revta bras. Biol., 1979a; 39(2):305-317.
16. Lopes H, de Souza, Kano R. On the types of some Oriental species of Sarcophagidae (Diptera), described by Francis Walker. Revta bras. Biol. 1979a; 39(2):305-317.
17. Lopes H, de Souza, Kano R, Shinonaga S, Karahashi H. Family Sarcophagidae. In: Delfinado, M. D. and Hardy, D. E. (eds.): A catalog of the Diptera of the Orientat Region, Honolulu. 1977; 3:557-583.
18. Lopes H, de Souza. A revision of Australian Sarcophagidae (Diptera). Studio. Ent. 1959; 2(1):33-67.
19. Lopes H, de Souza. Family Sarcophagidae. In: Evenhuis, N. L. (ed.): Catalogue of the Diptera of the Australasian and Oceanian Regions, Bishop Museum Special Publication. 1989; 86:721-732.
20. Macqaurt J. Dipteres exotiques nouveaux ou peu conn us. Menl. Soc. Sci. Agric. Lille. 1843; 2(3):162-460.
21. McAlpine JF. Phylogeny and classification of the Muscomorpha. In: McAlpine, J.F., Wood D.M. (Eds.), Manual of Nearctic Diptera, Research Branch, Agriculture Canada, Monograph 32, Ottawa, 1989; 3:1397-1505.

22. Nandi BC. Flesh flies (Diptera: Sarcophagidae) in the collection of Forest Research Institute, Dehra Dun, India. *Orient. Insects*. 1978; 12(3):377-386.
23. Nandi BC. Sarcophagid flies (Diptera: Sarcophagidae) from Uttar Pradesh, India. J Beng. nat. Hist. Soc. 1990a; 9(1):15-29.
24. Nandi BC. Sarcophagid flies (Diptera: Sarcophagidae) from Rajasthan, India. J. Beng. nat. Hist. Soc. 1990b; 9(1):49-55.
25. Nandi BC. Sarcophagid flies (Diptera: Sarcophagidae) from Meghalaya, India. tI. Beng. nat. Hist. Soc., 1991c; 10(2):38-49.
26. Nandi BC. Sarcophagid flies (Diptera: Sarcophagidae) from Mizoram, India. J. Beng. nat. Hist. Soc. 1992c; 11(2):33-50.
27. Nandi BC. Sarcophagid flies (Diptera: Sarcophagidae) from Mizoram, India. J. Beng. nat. Hist. Soc., 1992c; 11(2):33-50.
28. Nandi BC. Sarcophagid flies (Diptera: Sarcophagidac) from Gujarat, India. Proc. zool. Soc., Calcutta, 1992f; 45(2):187-196.
29. Nandi BC. Indian flesh flies (Diptera: Sarcophagidae) in the collection of the British Museum (Natural History), London. J. Beng. nat. Rist. Soc. 1995b; 14(1):50-63.
30. Nandi BC. Fauna of India and the adjacent countries-Diptera (volume x) Sarcophagidae, 2002; i-xxiv:1-608.
31. Pape T. The world *Blaesoxipha* Loew, 1861 (Diptera: Sarcophagidae). Entomologica Scandinavica. Supplement 1994; 45:1-247.
32. Pape T. Catalogue of the Sarcophagidae of the World (Insecta, Diptera). Mem. Entomol. Int. 1996; 8:1-558.
33. Pape T. A new genus of Paramacronychiinae (Diptera: Sarcophagidae), argued from a genus-level cladistic analysis. *Systematic Entomol.* 1998; 23:187-200.
34. Pape T, Blagodervo V, Mostovski MB. Order DIPTERA Linneaus, 1758' In: Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness. Zootaxa. 2011; 3148:222-229.
35. Park SH. On the unreported species of Sarcophagidae and Calliphoridae (Diptera) in Korea. *Korean* J. Zool., 1962; 5(2):1-8.
36. Parker RR. New flies of the genus *Sarcophaga* from Guam and Philippines. Proc. U. S. *natn.* Mus., 1917; 54:89-97.
37. Rohdendorf BB. Family Sarcophagidae. Fauna USSR, n£pt., (In Russion with German summary), 1937; 19(1):1-501.
38. Rohdendorf BB. Family Sarcophagidae. *Fauna USSR, n£pt.,* (In Russion with German summary) 1937; 19(1):1-501.
39. Rohdendorf BB. Uber das System der Sarcophaginen der athiopischen Fauna. Stuttg. Beitr. Naturk. 1963; 124:1-22.
40. Senior-White RA. A revision of the subfamily Sarcophaginae in the Oriental Region. Rec. Indian Mus. 1924; 26(3):193-283.
41. Senior-White RA, Aubertin D, Smart J, Diptera VI. Family Calliphoridae. In: Sewell, R.B.S. (ed.). The fauna of British India, including the remainder of the Oriental Region, London. 1940; 6:1-288.
42. Senior-White RA. A revision of the subfamily Sarcophaginae in the Oriental Region. Rec. Indian Mus., 1924; 26(3):193-283.
43. Sugiyama E, Kano R. Systematics of the Sarcophaginae of the Oriental Rogion based on the comparative morphology of the male genitalia (Diptera: Sarcophagidae). Jap, J sanit. Zool. 1984; 35(4):343-356.
44. Verves Yu G. Family Sarcophagidae. In: Soos, A., and Papp, L. (eds.). Catalogue of Palaearctic Diptera. 1986; 12:58-193.
45. Walker F. List of the specimens of dipterous insects in the collection of the British Museum, Part IV. London. 1849; 4:689-1172.
46. Walker F. Diptera. In: Insecta Saundersiana: or characters of undescribed insects in the collection of W. W. Saunders, London. 1852; 4:253-414.
47. Walker F. Catalogue of the dipterous insects collected at Singapore and Malacca by Mr. A. R. Wallace, with descriptions of new species. J. Proc. Linn. Soc. Land., Zool. 1856; 1:4-39.
48. Walker F. Catalogue of the dipterous insects collected in Waigiou, Mysol, and North Ceram by Mr. A. R. Wallace, with descriptions of new species, J Proc. Linn. Soc. Lond., Zool. 1864; 7:202-238.
49. Walker F. Catalogue of the dipterous insects collected in Waigiou, Mysol, and North Ceram by Mr. A. R. Wallace, with descriptions of new species, J Proc. Linn. Soc. Lond., Zool. 1864; 7:202-238.
50. Wiedemann CRW. *Aussereuropiiische zwei{lilgelige Insekten,* Hamm. 1830; 2:XII+1-684.
51. Yeates DK, Wiegmann BM, Courtney GW, Meier R, La mbkin C, Pape T. Phylogeny and systematics of Diptera: Two decades of progress and prospects. Zootaxa. 2007; 1668:565-90
52. Zumpt F. Calliphoridae (Diptera: Cyclorrhapha). Part IV. Sarcophaginae. Explor. Parc natn. Virunga, Miss. G. F. de Witte. 1972; 101:1-264.