

**SARCOPHAGIDAE ADULT.
ID WORKSHOP**

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*Workshop held in September 11st, 2010 in the 8th
Meeting of the European Association for Forensic
Entomology*



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- **Workshop objectives**

The specific objectives of the workshop are as follows:

- Bring forensic entomologists knowledge about of the Sarcophagidae identification because are very important component of the community sarcosaprophagous (Smith, 1996; Povolny & Verves, 1997).
- Accustom to anatomical terminology necessary for identification.
 - External structures
 - Male terminalia

Povolny & Verves (1997) notice that the problems of identification of the species Sarcophaginae are the cause of the confusion that exist related to forensic cases cited in the literature.

- Provide the methodology for the previous preparation to the study of male terminalia. Generally only males of this family can be identified, and most of the time only by examination of dissected terminalia.
 - Apply the methods discussed in specific cases.
-

Who are they?

- Three subfamilies with different breeding habits (Pape, 1998):
 - **Miltogramminae**: kleptoparasite or parasite obligate (*Senotainia tricuspis*). Some species breeding in buried vertebrate carrion (Szpila, Voss & Pape, 2010).
 - **Paramacronychinae**: predators on immatures of bumblebees, mainly prepupae); insect predators and scavengers (*Sarcophila* and *Wohlfahrtia*) and some species that produce myiasis in mammals (*Wohlfahrtia*)
 - **Sarcophaginae**: exploit small carrions like dead snails and insects and small vertebrate corpses, some of them may attack wounded or moribund insect-preys, and many are predators of shell-bearing pulmonate snails. Palearctic *Blaesoxipha* are obligated insect parasitoids attacking grasshoppers and tenebrionid beetles. A few species breed in large vertebrate corpses, faeces and various types of organic waste.

Which are useful in forensic practice:

- A few species of Sarcophaginae and Paramacronychinae (*Sarcophila* and *Wohlfahrtia*) and Miltogramminae (*Phylloteles pictipennis*, Palaeartic R.).
 - The problem is
 - There are disagreements in assign the generic level especially in the Sarcophaginae subfamily.
 - This is especially relevant for the genus *Sarcophaga* which contains about 800 species worldwide.
 - Its defenders, however, divide them into sub-genres for easy handling, identification and other proposals.

Identification Keys

- Pape, T. 1987. *The Sarcophagidae (Diptera) of Fennoscandia and Denmark*. Fauna Entomologica Scandinavica, 19 . Hardback 203 pp.,
- Pape, T. 1998. Sarcophagidae. In: Papp, L. & Darvas, B. (eds), Contributions to a manual of Palaearctic/European Diptera. - pp. 649–678 Science Herald; Budapest.
- Rohdendorf, B. B. 1937. *Family Sarcophagidae* in Bei-Bienko, G. Ya. *Keys to the Insects of the European part of the USSR* Fauna SSR (NS) 12: xv, 1-496. [In Russian; English translation 1988, pp. 1021–1096; Washington, D.C.]
- Rohdendorf, B. B., 1930-1975 *Sarcophaginae*, in Lindner, E. *Fliegen die Palaarktischen Region*. 11 64h, 1-232; 1985, 64h. *Sarcophaginae* (Lieferung 330) 1-297; 1993 64h. *Sarcophaginae* (Lieferung 331) 1-441 , 90 Abbildungen (figures).
- Povolny & Verves (1997) The Flesh-Flies of Central Europe (Insecta, Diptera, sarcophagidae). Spixiana, Supplement 24: 1-260.
- Verves Y. 1985. Sarcophaginae. In Die fliegen der Palaarktischen region (Lindner E, ed.). Stuttgart: E. Schweizerbartsche Verlagsbuchhandlung, pp. 297-440.

Catalogues

- Pape, T. 1996. Catalogue of the Sarcophagidae of the world (Insecta: Diptera). *Memoirs of Entomology International* 8: 1-558.
- Verves, Yu.G., 1986. *Family Sarcophagidae*. In: Soós Á. & Papp L. (eds.), *Catalogue of Palaearctic Diptera*, 12. Akadémiai Kiadó, Budapest - Elsevier, Amsterdam: 58-193.
 - Pape, T. 2004. Fauna Europaea: Diptera, Sarcophagidae. Europaea. version 1.3, <http://www.faunaeur.org>. last update 3 June 2010 | version 2.2
 - Citations in Zoological Record.
 - International Code on Zoological Nomenclature — ICZN

- **Sarcophaginae: Diagnostic characters**
 - Flies robust (+20 mm).
 - Body color black background with grey microtomentum, white or silver, changing with the incidence of light.
 - Back of coxae III setulosa.
 - Abdominal bloom forming a changing pattern of incidence of light, usually formed as a checkerboard



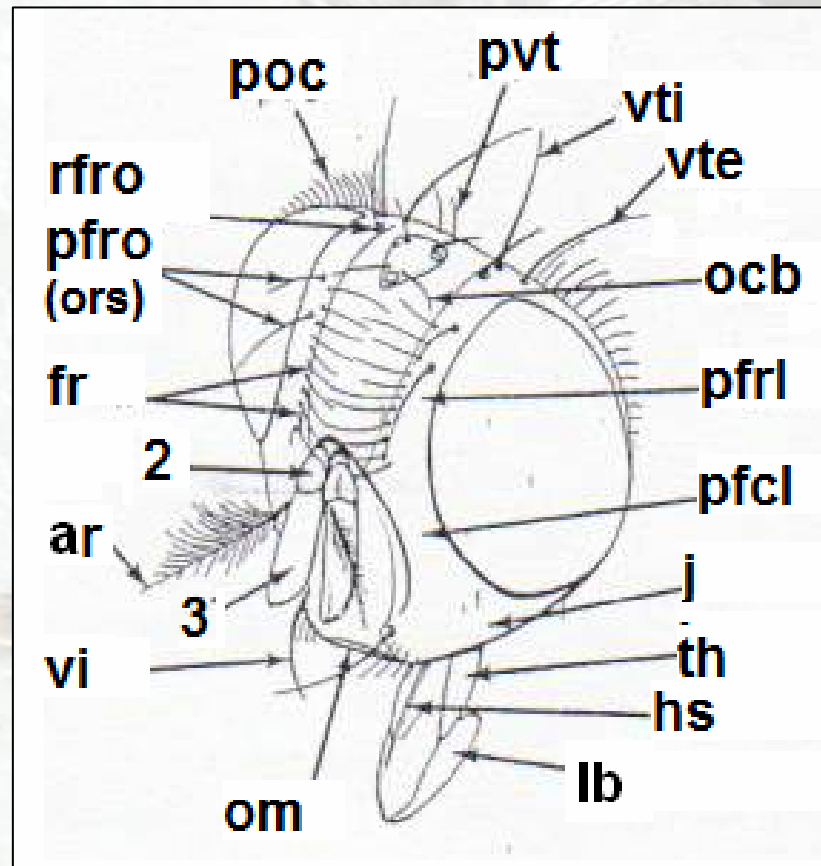
http://upload.wikimedia.org/wikipedia/commons/3/38/Graue_Fleischfliege1.jpg

- Paramacronychinae
(Sarcophila and Wohlfahrtia).
 - Back of coxae III bare.
 - Abdomen very powdery, with some isolated patches, still not changing with the incidence of light.



http://commons.wikimedia.org/wiki/File:Fly_April_2008-9.jpg

- Main external features

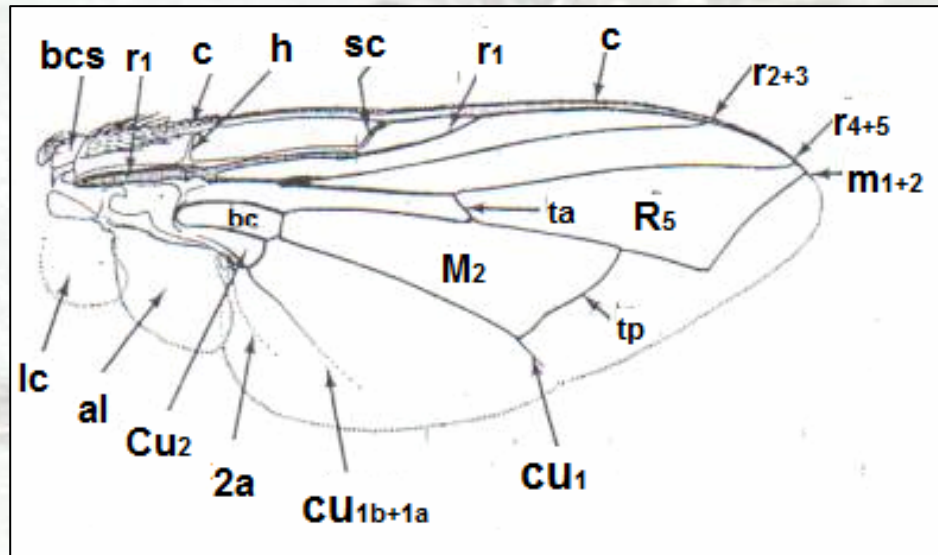


Chaetotaxy of head (frontolateral view).

ar, arista; fr, frontals; hs, haustellum; j, jowls; lb, labella; ocb, ocellars (ocellars, ocular) bristles; om, oral margin; pfcl, parafacial; pfri, parafacial; pfro (ors), proclinate fronto-orbitals; poc, postocellars; pvt, postverticals; rfro, reclinate fronto-orbitals; th, theca; vi, vibrissae; vte, external verticals; vti, internal (interior) verticals; 2, 3, 2nd and 3rd antennomere.

Redrawn from Gregor in Greenberg et al. 1971. Flies and Disease, Vol. I: Ecology, classification and biotic association. Princeton University Press, Princeton, New Jersey. 856 p.

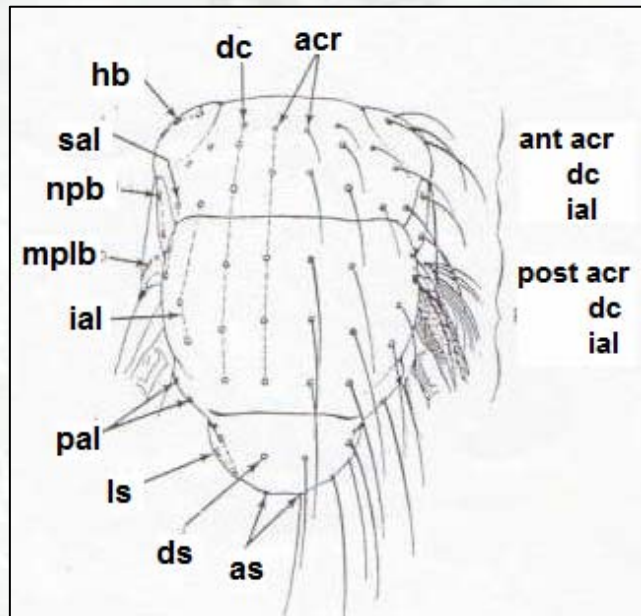
- Main external features



Forewing (dorsal view)

al, alula; bc, basal cell; bcs, basicosta; c, costa; cu_1 , cu_2 , cubital veins; Cu_2 , cubital (anal) cell; cu_{1b+1a} anal vein: h, humeral (cross) vein; lc, lower squama (calyptra); m_{1+2} , medial vein; M_2 , medial (discal) cell; sc, subcosta; ta (r-m). anterior cross or m-vein; 2a, anal vein

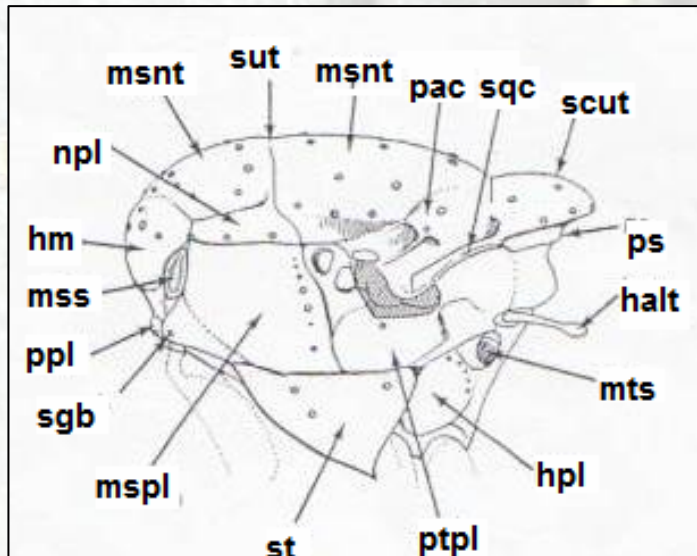
Redrawn from Gregor in Greenberg et al. 1971. Flies and Disease, Vol. I: Ecology, classification and biotic association. Princeton University Press, Princeton, New Jersey. 856 p.



• **Main external features**

Thoracic chaetotaxy (dorsal view).

acr, acrostichals; as, apicoscutellars; ds, discoscutellars; dc, dorsocentrals; hb, humerals; ial, intra-alars; ls, latero-scutellars; mplb, mesopleurals; npb, notopleurals; pal postalars; sal, supraalars.

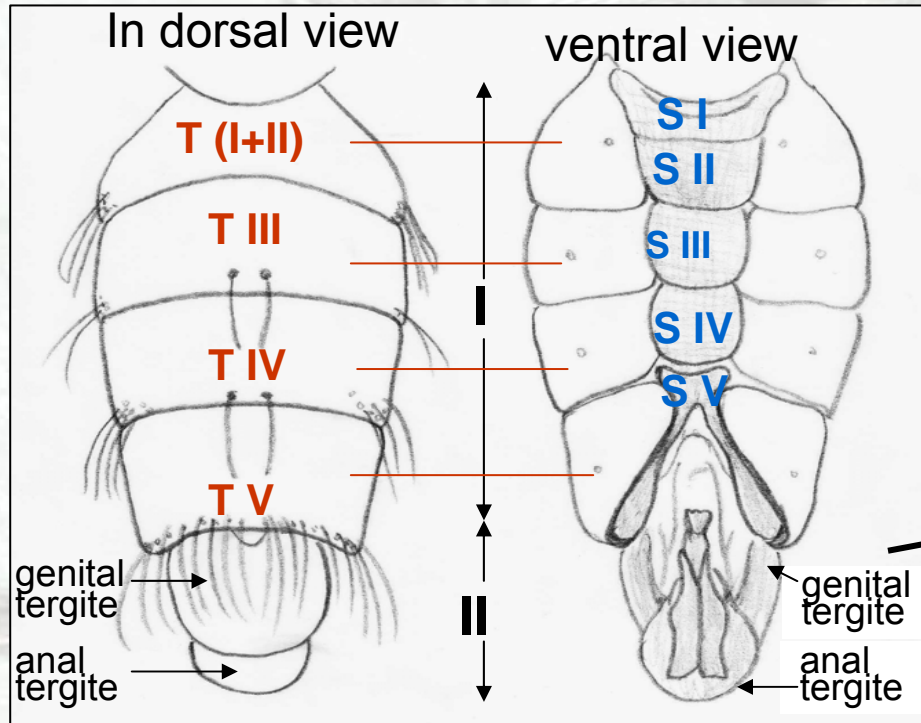


Thoracic chaetotaxy lateral view).

halt, halter; hm, humerus; hpl, hypopleuron; msnt, mesonotum; mspl, mesopleuron; mss, anterior (mesothoracic) spiracle; mts, posterior (metathoracic) spiracle; npl, notopleuron; pac, postalar callus; ppl, propleuron; ps, postescutellum; ptpl, pteropleuron; scut, scutellum; sgb, stigmatic bristle; sqc, supra-squamal carina; st, sternopleuron (with position of sternopleurals 2:1); sut, suture

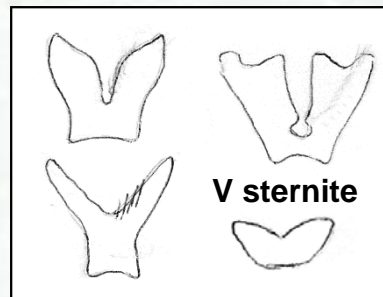
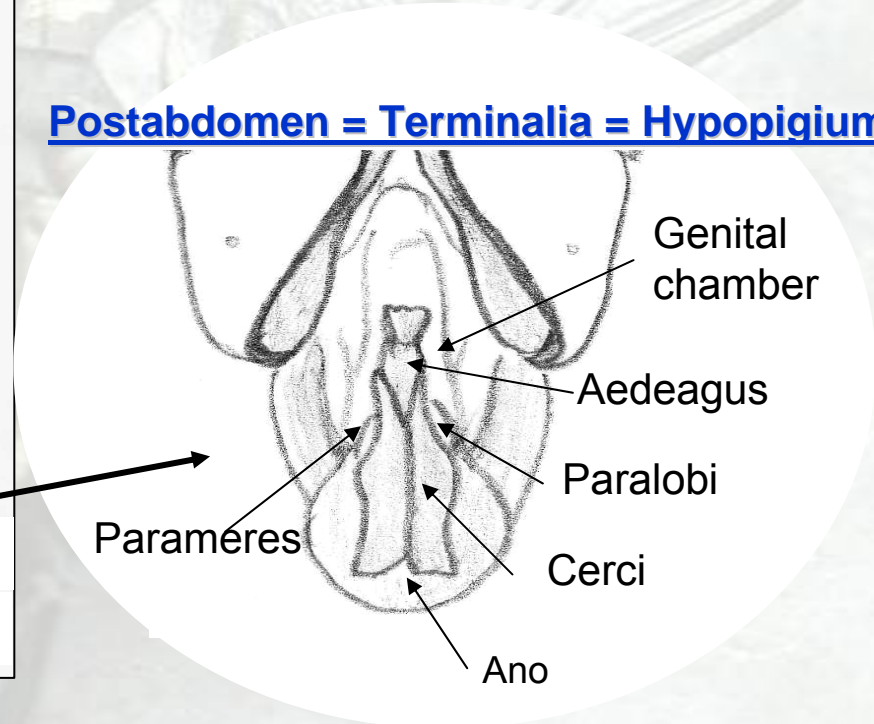
Redrawn from Gregor in Greenberg et al. 1971. Flies and Disease, Vol. I: Ecology, classification and biotic association. Princeton University Press, Princeton, New Jersey. 856 p.

• Male abdomen: I. Preabdomen, II. Postabdomen



T: Tergite; S: sternite.

Postabdomen = Terminalia = Hypopigium



V sternite

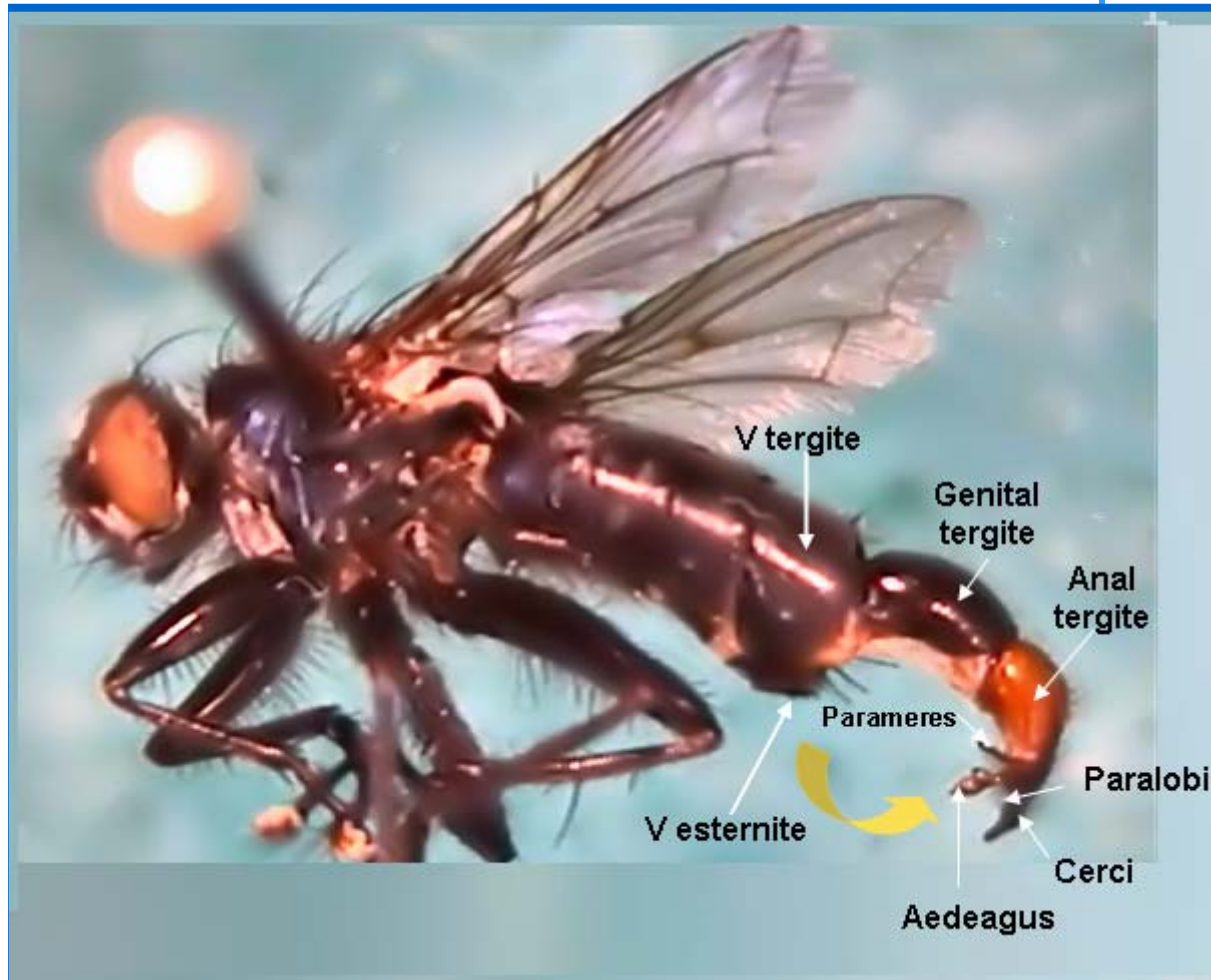
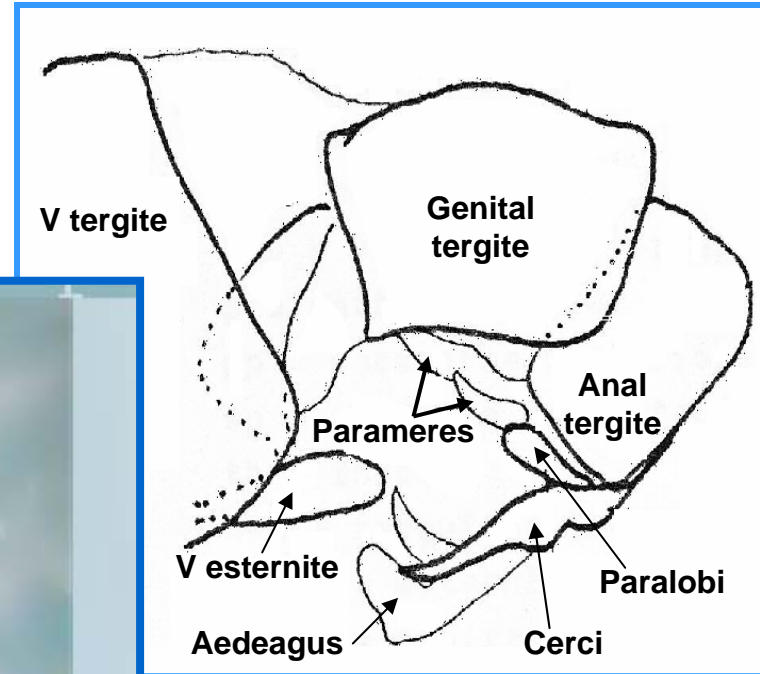
Redrawn from
Lehrer, 2000, La structure de
l'abdomen des Sarcophaginae
(Diptera, Sarcophagidae),
Entomologica, Bari, 34, p. 155.

**Genital tergite = Tergite pregenital
Anal tergite = Epandrium (Ano +
aedeagus and other structures)**

Terminology of male terminalia

Sarcophagidae

The genera and species of the tribe Sarcophagini require any detailed aedeagal descriptions, and the morphological terms applied within this group will be given particular attention.



Cerci = Internal forceps
Paralobi = external forceps = coxitos = dististyli = anal plates = surstyli = forceps anal

• **Phallosome (Aedeagus + Tergosternum)**

- *Sarcophaga carnaria*

Tergosternum = Hypandrium

Apodeme = phallogenema

Anterior = pregonito

Parameres = Gonapofisis = Gonopods

Posterior = postgonito

Membrane

Vesicae

Harpes = laterals arms of paraphallus = dorsolaterals processes

Styli = lateral filament

Sperm pump sclerite

Eyaculatory apodeme

Spinus titillatorius = Epiphallus

Basiphallus = Theca = phallophore

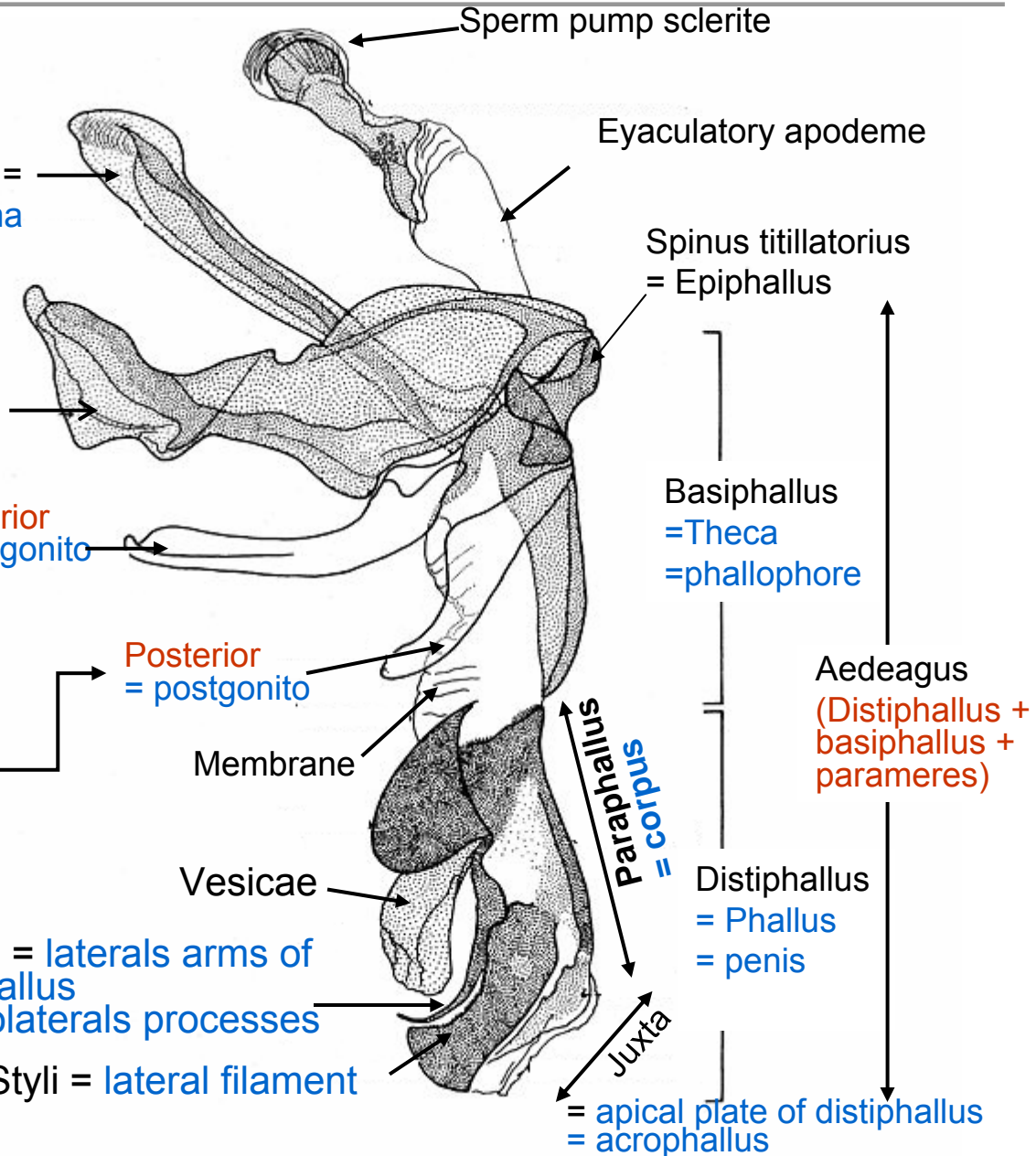
Aedeagus (Distiphallus + basiphallus + parameres)

Distiphallus = Phallus = penis

Paraphallus = corpus

Juxta = apical plate of distiphallus = acrophallus

Figure according http://commons.wikimedia.org/wiki/File:Phallosome_de_Sarcophaga_carnaria.jpg
 Source: Lehrer, A.Z., 2000, La structure de l'abdomen des Sarcophaginae (Diptera, Sarcophagidae) - Entomologica, Bari, vol. 34, p. 163.

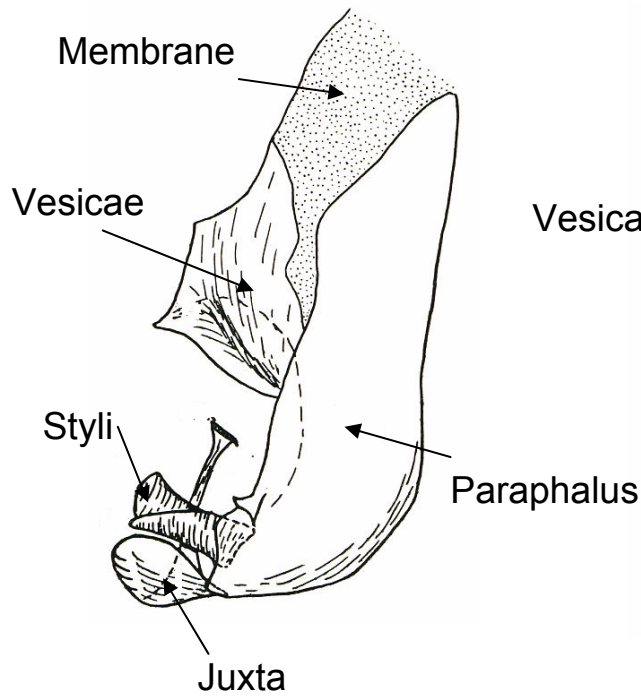


• **Terminology of male terminalia**

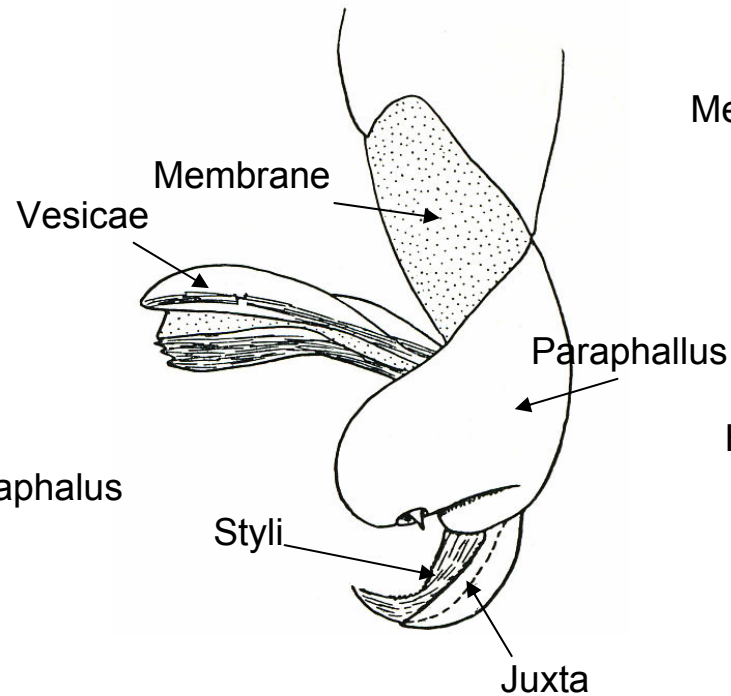
- Phallosome = (Aedeagus + Tergosternum)
- Tergosternum = IX segmento de Rohdendorf, 1937 = Hypandrium = gabelplatte
- Aedeagus = (Basiphallus + distiphallus + parameres)
- Parameres = Gonapofisis = Gonopods = pregonitos + postgonitos
- Basiphallus = Theca = phallophoro
- Spinus titillatorius = epiphallus
- Distiphallus = (Paraphallus + juxta) = phallus = penis
- Paraphallus = (sclerotization dorsal + membranous ventral part) = corpus (sclerocorpus + membranocorpus)
- Harpes = Ventral processes of sclerocorpus = Lateral plates of paraphallus
- Auriculas = Paraphallus (Helicophagella)
- Membranal process (es)
- Membrane
- Vesicae = Ventralia = Membranal process
- Juxta = Apical plate of distiphallus = Acrophallus.
- Lateral arm (process) of apical plate or juxta.
- Styli = Lateral filament
- Sperm pump sclerite
- Eyaculatory apodeme

Diversity of forms in the Sarcophaginae distiphallus

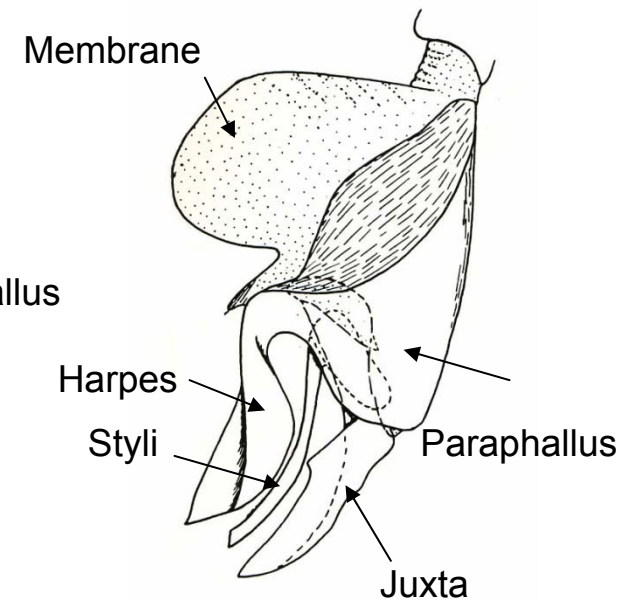
(Redrawn from Roback, 1954) The evolution and taxonomy of Sarcophagidae (Diptera: Sarcophagidae). Illin. Biol. Monogr. 23, 1–181.



Sarcophaga
(Helicophagella) melanura
Meigen 1826



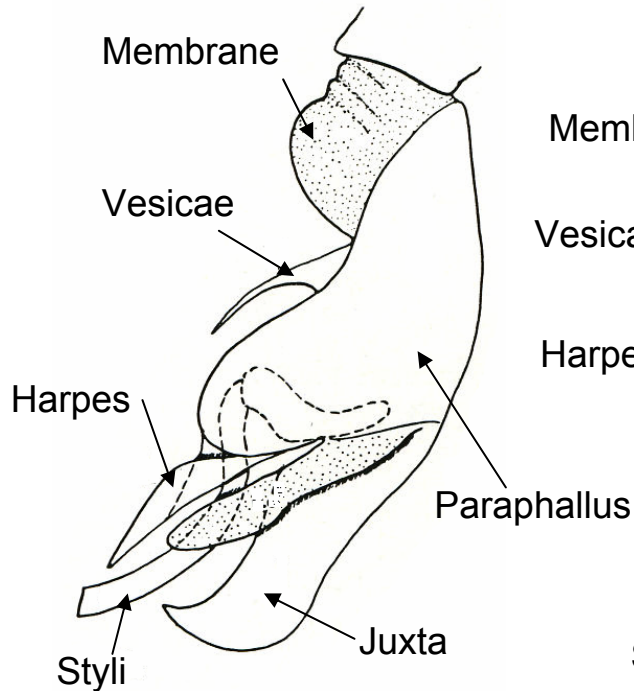
Sarcophaga
(Sarcotachinella)
sinuata Meigen 1826



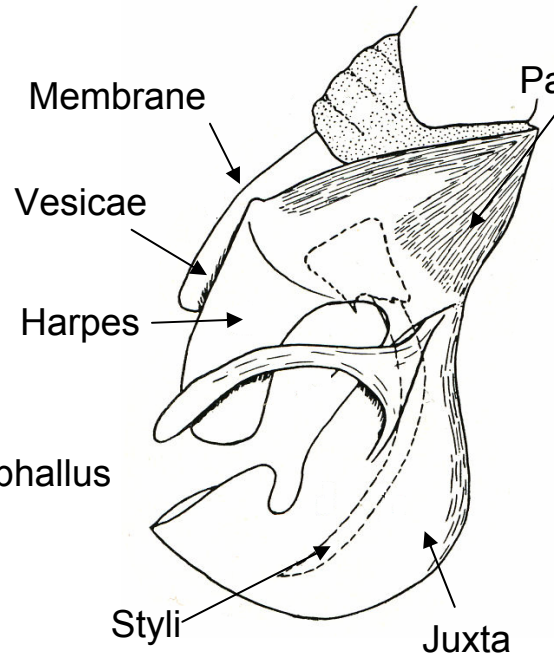
Sarcophaga
(Heteronychia)
vagans Meigen 1826

Diversity of forms in the Sarcophaginae distiphallus

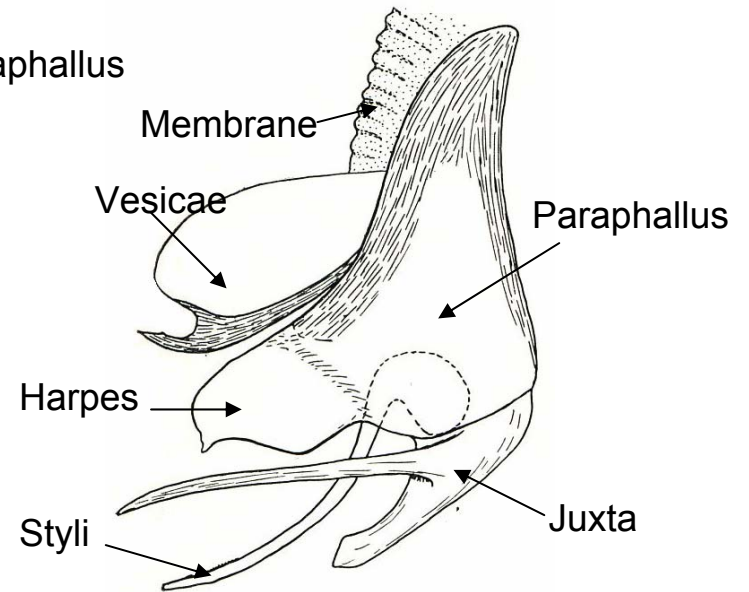
(Redrawn from Roback, 1954) The evolution and taxonomy of Sarcophagidae (Diptera: Sarcophagidae). Illin. Biol. Monogr. 23, 1–181.



***Sarcophaga*
(*Heteronychia*)
haemorrhhoa Meigen
1826**



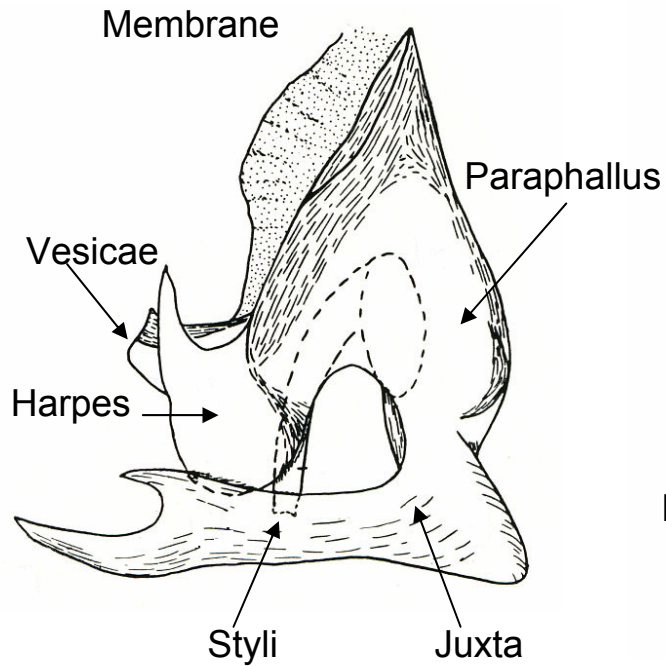
***Sarcophaga*
(*Discachaeta*) *cucullans*
Pandelle 1896**



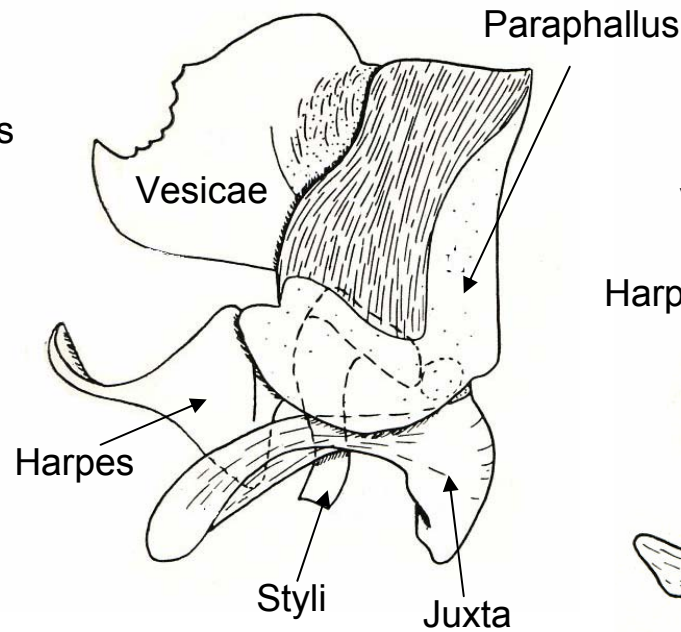
***Sarcophaga*
(*Liosarcophaga*) *dux*
Thomson 1869**

Diversity of forms in the Sarcophaginae distiphallus

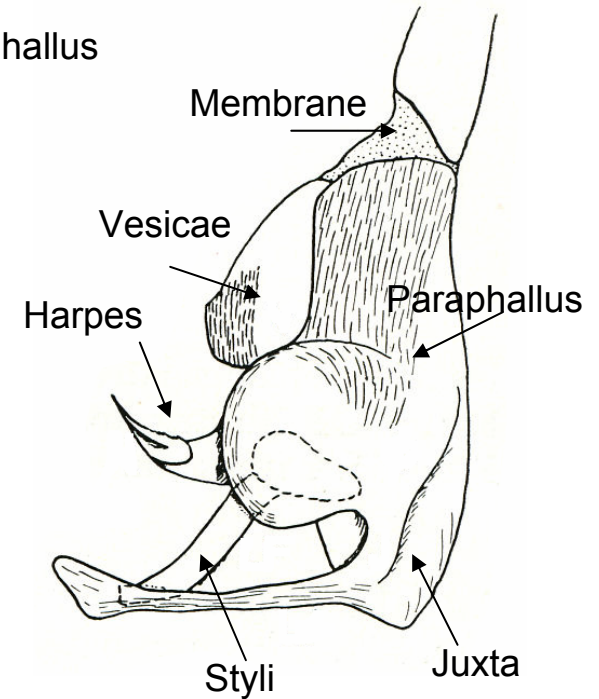
(Redrawn from Roback, 1954) The evolution and taxonomy of Sarcophagidae (Diptera: Sarcophagidae). Illin. Biol. Monogr. 23, 1–181.



Sarcophaga (Robineauella) caerulescens Zetterstedt 1838



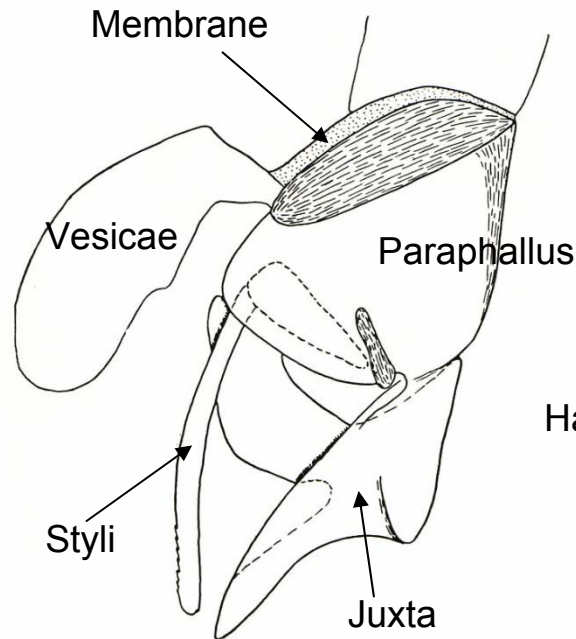
Sarcophaga (Liopygia) argyrostoma (Robineau-Desvoidy 1830)



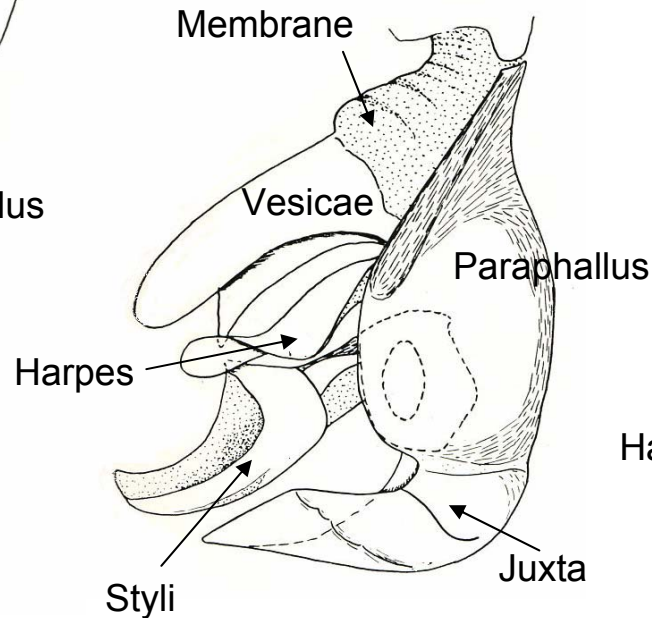
Sarcophaga (Liopygia) crassipalpis Macquart 1839

Diversity of forms in the Sarcophaginae distiphallus

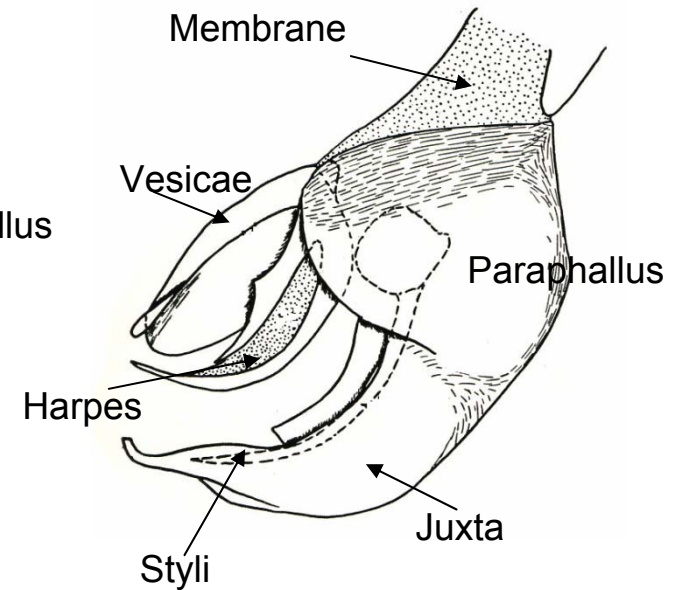
(Redrawn from Roback, 1954) The evolution and taxonomy of Sarcophagidae (Diptera: Sarcophagidae). Illin. Biol. Monogr. 23, 1–181.



Sarcophaga (Pandelleana) protuberans Pandelle 1896



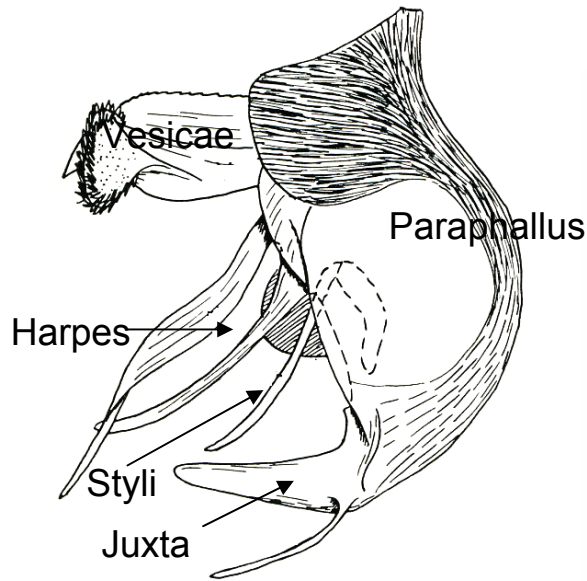
Sarcophaga (Rosellea) atrix Pandelle 1896



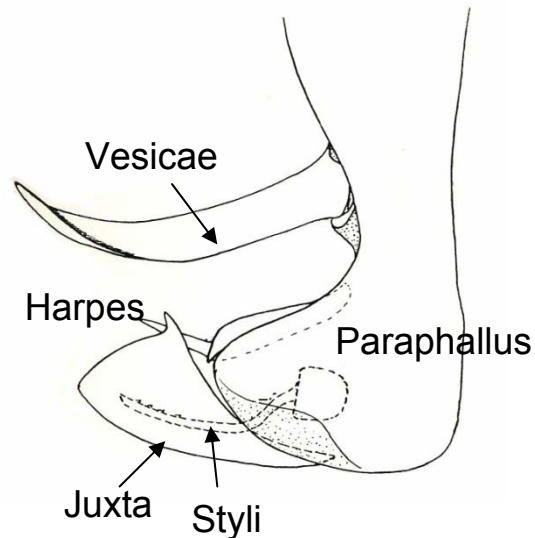
Sarcophaga (Myorhina) nigriventris Meigen 1826

Diversity of forms in the Sarcophaginae distiphallus

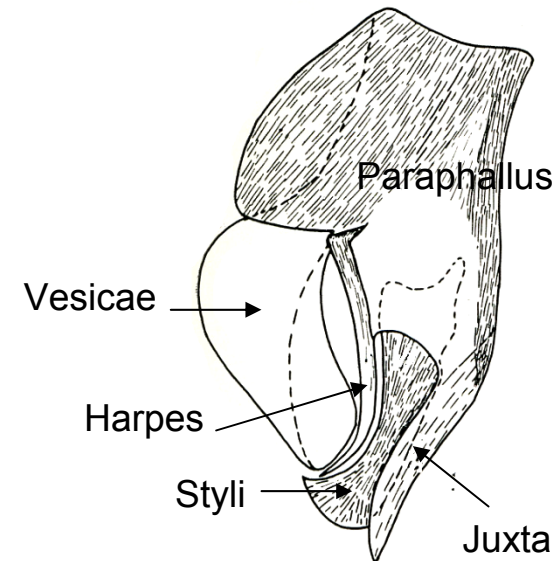
(Redrawn from Roback, 1954) The evolution and taxonomy of Sarcophagidae (Diptera: Sarcophagidae). Illin. Biol. Monogr. 23, 1–181.



Sarcophaga (Thyrsocnema) incisilobata Pandelle, 1896



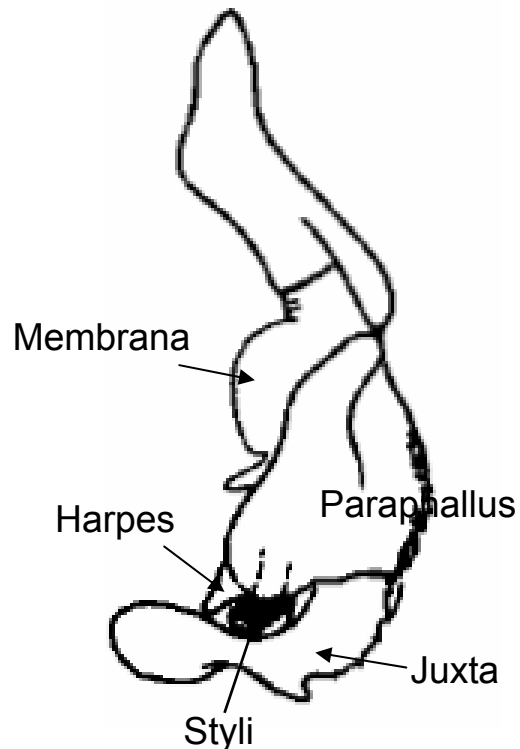
Sarcophaga (Bercaea) africa (Wiedemann 1824)



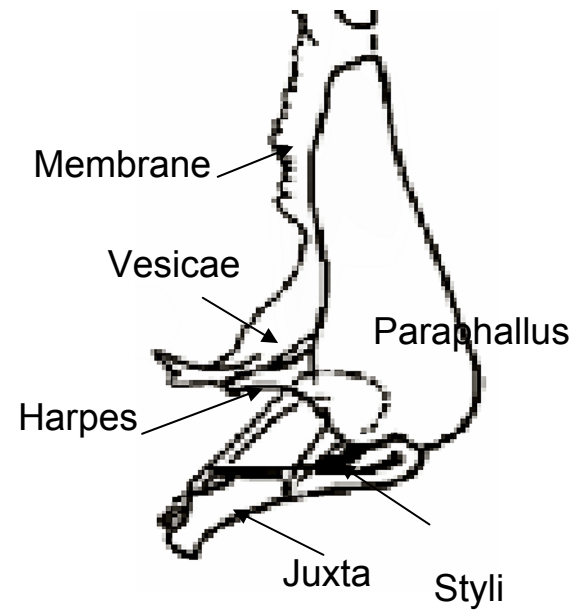
Sarcophaga (Sarcophaga) carnaria (Linnaeus 1758)

Diversity of forms in the Sarcophaginae distiphallus

(Redrawn from PERIS et al., 1999. Los Parasarcophagina (Diptera, Sarcophagidae) de la Península Ibérica. Boletín de la Real Sociedad Española de Historia Natural (Sec. Biol.), 95(1-2): 115-134.



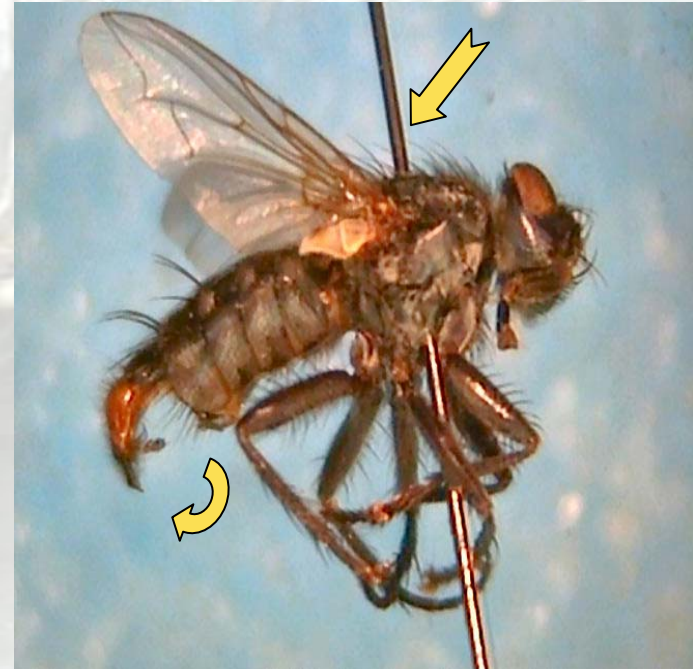
***Sarcophaga (Liopygia) cultellata* Pandelle 1896**



***Sarcophaga (Liosarcophaga) tibialis* Macquart 1851**

•Preserving

- Collected specimens should be pinned like other flies, but male of the Sarcophaginae should have their terminalia extended, should be spread when fresh specimens are pinned, to allow the examination of the phallus and other genitalic features in order to provide a definite identification.
- Alcohol preservation of adult specimens is not recommended, unless for DNA analysis or soft tissue studies. When the specimens have been previously in alcohol, they become frequently distorted and spreading the male genitalia is difficult, or impossible.



Procedure to spread the male genitalia:

- Hold the abdomen carefully with tweezers as close as possible to the postabdomen.
- With the help of a mini hook (can be easily manufactured with a trifle or an insect pin "0" or "00" set in a handle). Bend the postabdomen slightly upward, until the phallic structures appears. Perform this operation on a tray dissection with water or alcohol from 70% to avoid losses by detachment.
- Secure with a pin to prevent the retreat again.
- Let the specimen dry for 2 to 3 days and then remove the pin. The genitalia will remain spread for future examination.



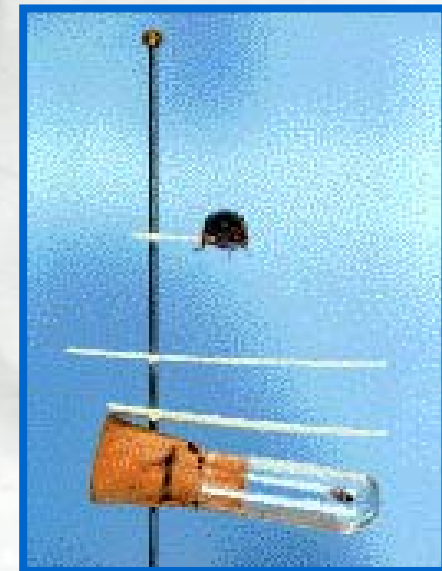
- If the specimens are hard to be manipulated, it is dangerous to take the risk of breaking them. The male specimens of very few years old are easily to be relaxed in a humid container (usually with little damage to pollinosity) and genitals may be exposed (as explained above) or removed with fine tweezers .

Procedure:

- If observation of terminalia “in situ” provides all the details needed for identification is not necessary to separate the terminalia of the specimen, otherwise, proceed as follows:
 - Remove the postabdomen from the abdomen and lay in a small well with KOH 10% (3 tablets in 10 ml of water).
 - Heat on a stove or burner, preventing boiling.
 - Remove from potash (KOH) and examined. Muscles and other organic debris should be gone after maceration, repeat until you can.

Procedure:

- When the terminalia is fully macerated, proceed to separate the different components of the complex phallic.
- Very fine needles will be necessary. We can manufacture them with entomological pins (number 1 or other suitable size).
- Put the structures, separated and cleaned of debris, to another well with distilled or boiled water. Then put them into a slide of glass with a drop of alcohol in it. We also can add a few drops of glycerin in order to study under magnification.
- The male terminalia of the sarcophagid have much volume, it is not appropriate to **mount** it in preparation, it can be left in a microvial with neoprene stoppered.
- Avoid glasses with cork stoppers, cork tannin alter the samples in the course of time. Store in glycerol or glycerin just enough to cover the sample.
- We must be careful when we put the stopper pulling out the air inserting a pin between the cap and vial.
- The vial should be pinned in the same pin which we have pinched the rest of the specimen.



• Thank you for your attention...

...and now it is your turn!