

# Systematics and Phylogeny of *Sarcophaga* (*Heteronychia*) (Diptera, Sarcophagidae)

by  
Daniel Whitmore

Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale, Verona;  
Università degli Studi di Roma "La Sapienza"

E-mail: whitmore\_d@yahoo.it

## Background

Flesh-flies or Sarcophagidae are a relatively speciose family of higher brachyceran flies (Diptera, Brachycera), with over 2,500 species worldwide and about 800 species in the Palearctic region. Although the higher classification of the family and its subdivision into 3 subfamilies is well corroborated and universally recognized among specialists of the group, the classification of the large genus *Sarcophaga* Meigen, 1826 has been debated between 'splitters' and 'lumpers'. Pape (1996), in his World flesh-fly Catalogue, chose to 'go with the lumpers' and maintained all species of *Sarcophaga* s.l. within a single genus subdivided into numerous subgenera. The monophyly of only one subgenus, *Helicophagella* Enderlein, 1928, has been tested with a modern cladistic analysis (Blackith et al. 1998). Do the subgenera of *Sarcophaga* represent natural groupings?



Fig. 1: *Sarcophaga* (*Heteronychia*) sp. n., male.

## Problem

*Heteronychia* Brauer & Bergenstamm, 1869 (Fig. 1) is currently the most species-rich subgenus of *Sarcophaga* with over 100 valid species (Pape 1996), almost all of which Palearctic and 60% of which with a Mediterranean or Euro-Mediterranean distribution. *Discachaeta* Enderlein, 1928 is a small subgenus including 6 European species, two of which endemic of Madeira. Morphologically, this taxon appears to be very closely related to *Heteronychia*. Do *Heteronychia* and *Discachaeta* form a monophyletic group and does a sister-group relationship exist between them? Or is *Heteronychia* paraphyletic with respect to *Discachaeta*?

## Aims

The aim of the project is two-fold: 1) a taxonomic review of the subgenus *Heteronychia*; 2) a phylogenetic (cladistic) analysis of the group, including species of *Discachaeta*, based on a matrix of morphological characters, with the objective of testing its monophyly and defining relationships with other subgenera of *Sarcophaga*, particularly with *Discachaeta*.

## Methods

Study of several thousand specimens from public collections (e.g. Zoological Museum of Copenhagen, Natural History Museum of Stockholm, Zoological Institute of St. Petersburg, Smithsonian Institution, Washington D.C.) and from field collections in various regions of central-southern Italy. Construction of a morphological character matrix to be analysed by a phylogenetic analysis software. Documentation of the finer morphological details, particularly of the male terminalia, using SEM microscopy.

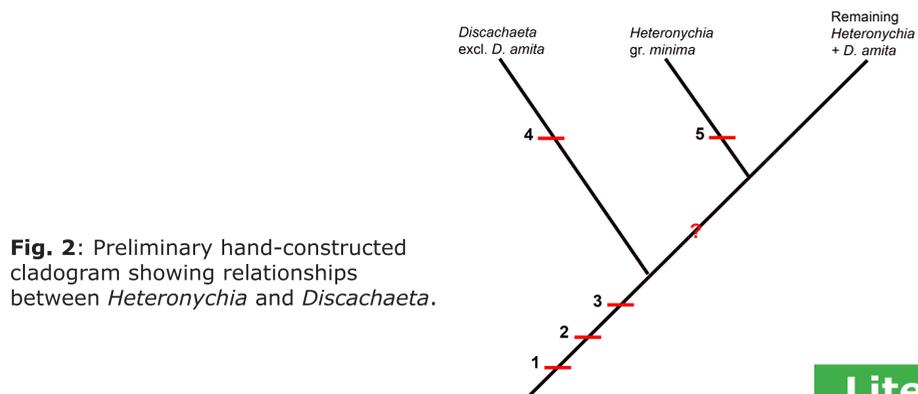


Fig. 2: Preliminary hand-constructed cladogram showing relationships between *Heteronychia* and *Discachaeta*.

## Phylogenetic hypotheses

Fig. 2 shows a preliminary cladogram of the studied group, constructed by hand. According to this hypothesis, *Heteronychia* + *Discachaeta* can be defined by three synapomorphies:

1. Vesica usually reduced, undivided, laminar and more or less parallel to longitudinal axis of distiphallus (Figs. 3, 4);
2. Protandrial segment and epandrium slightly to strongly elongate (Fig. 5)
3. Basiphallus elongate (Fig. 6)

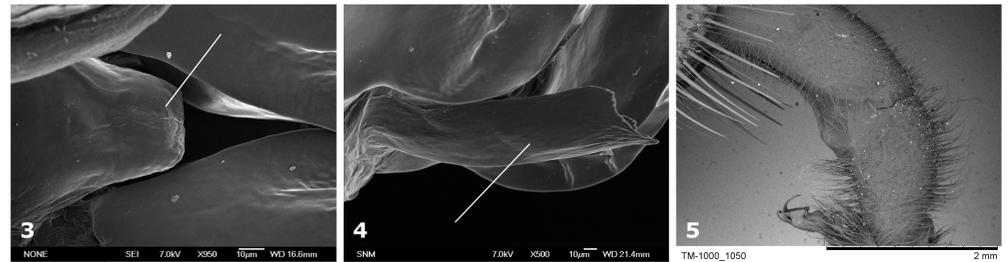
Within this clade, a group comprising all species of *Discachaeta* except *Sarcophaga* (*D.*) *amita* Rondani, 1860 can be distinguished by the following apomorphy:

4. Juxta with long sclerotized 'arm-like' processes at base (Fig. 7)

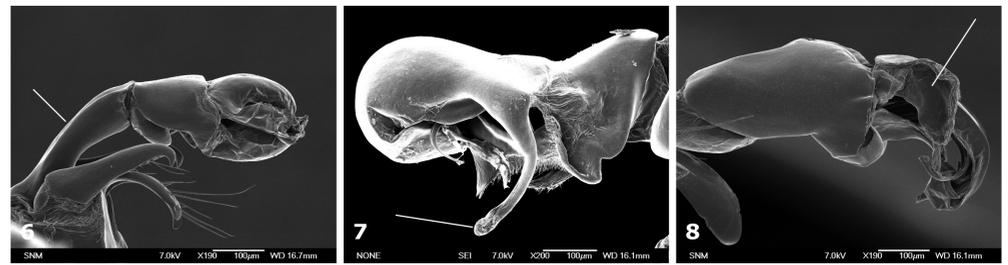
Within the remaining group of *Heteronychia* + *S. amita*, a group comprising mostly Mediterranean species, the *S. (H.) minima* Rondani, 1862-group, can be distinguished by the following apomorphy:

5. Juxta with lateral membranous 'ear-like' expansions at base (Fig. 8).

At the present stage of the research no synapomorphy has been found distinguishing *Heteronychia* + *S. amita* from the remaining species of *Discachaeta*. This reinforces the hypothesis that *Heteronychia* could be paraphyletic with respect to *Discachaeta*.



Figs. 3-5: 3. Vesica of *Sarcophaga* (*Heteronychia*) *santospintosi* (Lehrer & Báez, 1986); 4. Vesica of *S. (H.) villeneuveana* (Enderlein, 1928); 5. Protandrial segment and epandrium of *S. (Heteronychia)* sp.



Figs. 6-8: 6. Phallus of *Sarcophaga* (*Heteronychia*) *mutila* Villeneuve, 1912, showing length of basiphallus; 7. Distiphallus of *S. (Discachaeta) cucullans* Pandellé, 1896 showing arm-like appendages at base of juxta; 8. Distiphallus of *S. (Heteronychia) thirionae* (Lehrer, 1975) showing the ear-like expansions at base of juxta.

## New species and new synonymies

In the first year and a half of work on *Heteronychia* several new species have been discovered (about 10); three new species from the Mediterranean area are being described in two papers which are in preparation; the remaining new species (from Europe and central Asia), some of which are morphologically very similar to already described ones, require further studies. Papers treating various nomenclatural and taxonomic issues within *Heteronychia* are also being prepared, including several new synonymies and resurrected names.

## Future developments

Following this project, further studies could be carried out on smaller species-groups, possibly using molecular techniques. Phylogeographical studies of species-groups occurring predominantly in the Mediterranean region could provide interesting information on the origin and dispersion of these taxa.

## Funding

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## Literature cited

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