



**Original article (Orijinal araştırma)**

**Redescription of a rare flesh fly species, *Sarcophaga (Latistyla) czernyi* Böttcher, 1912 (Diptera: Sarcophagidae), with the ultrastructure of the male terminalia<sup>1</sup>**

Nadir bir et sineği türü, *Sarcophaga (Latistyla) czernyi* Böttcher, 1912 (Diptera: Sarcophagidae)'nin erkek terminalyası ultrastrüktürüyle yeniden tanımlanması

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**Abstract**

*Sarcophaga (Latistyla) czernyi* Böttcher, 1912 (Diptera: Sarcophagidae) is a poorly known Palearctic species, which is here newly recorded from Turkey based on a single male specimen collected from Antalya Province in 2016. The species has an interesting and unique structure of the phallus with large, tubular styli with recurving teeth and a lobate and hook-shaped vesica. This study redescribed of the species with the external and genital morphology documented with photography and the first data on the ultrastructure of male terminalia using SEM. The taxonomic status, synonymy and subgeneric inclusion of the species are discussed.

**Keywords:** *Macabiella*, new record, phallus, SEM, synonymy

**Öz**

*Sarcophaga (Latistyla) czernyi* Böttcher, 1912 (Diptera: Sarcophagidae) az bilinen ve Türkiye'de ilk kez kaydedilen Paleartik bir türdür. Bu çalışmanın incelenen materyali, 2016 yılında Antalya İli'nden toplanan bir erkek örneğine dayanmaktadır. Tür, halka şeklinde dişlere sahip boru şeklindeki styli ve lob benzeri kanca şeklindeki vesica ile oldukça ilginç ve benzersiz bir aedeagal yapıya sahiptir. Bu çalışma, SEM kullanılarak erkek terminalya yapısı hakkındaki ilk verilerle türü yeniden tanımlanmaktadır. Dış ve genital morfolojiler, kameraya monte edilmiş bir stereo mikroskop ile tarif edilmiş ve fotoğraflanmıştır. Türün taksonomik durumu, sinonimi ve altcins dahil edilmesi de tartışılmıştır.

**Anahtar sözcükler:** *Macabiella*, yeni kayıt, phallus, SEM, sinonim

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## Introduction

Sarcophagidae is the second-most diverse family of Oestroidea with about 3,000 valid species worldwide (Pape et al., 2011). *Sarcophaga* Meigen, 1826 comprises more than 850 valid species separated into numerous subgenera and is thereby the largest genus in the family (Whitmore et al., 2018; Pape, 2019).

As in the most of the sarcophagids, *Sarcophaga* spp. also share a uniform external morphology such as gray body coloration, three longitudinal black stripes dorsally on thorax, and checkered patterns on abdomen (Mello-Patiu, 2016). Therefore, an accurate identification of the species strongly depends on a detailed examination of the terminalia of both sexes, but in particular of the male (Pape, 1996; Whitmore et al., 2018). Although the species have a wide range of larval feeding habits, the species are generally characterized as necrophagous, saprophagous or predatory on various terrestrial invertebrates (Mello-Patiu, 2016; Whitmore et al., 2018).

*Sarcophaga (Latistyla) czernyi* Böttcher, 1912 has a narrow distribution and has so far only been recorded from Croatia, Greece, Israel and Lebanon (Lehrer, 2006; Xue et al., 2011; Krčmar et al., 2019), to which can now be added Turkey. The species was initially described by Böttcher (1912) as *Sarcophaga czernyi* based on two males collected by L. Czerny in Croatia. For a long time, the taxonomic status, particularly the generic and subgeneric rank, was unstable (Enderlein, 1928; Rohdendorf, 1937; Strukan, 1970; Verves, 1986, 1990; Lehrer, 1994; Pape, 1996). In the most recent studies, *S. czernyi* was placed in *Latistyla* Strukan, 1970 at genus (Xue et al., 2011) or subgenus level (Krčmar et al., 2019).

Ever since the publication of the first Turkish checklist with 81 species by Kara & Pape (2002), the number of flesh flies known from Turkey has gradually increased (Whitmore et al., 2018; Verves et al., 2018; Pekbey, 2019), and it has now risen to 157 with the addition of this new record.

## Materials and Methods

The material is represented by a single male of *Sarcophaga (Latistyla) czernyi*, deposited in the entomology collection of Yozgat Bozok University of Turkey and collected in Turkey, Antalya Province, Burmahan village, 37°11'06" N, 31°16'28" E, 700 m, 08.VII.2016.

For humidification, the dry specimen was kept for 24 h in a moisture chamber, and the terminalia were extended from the abdomen using fine insect pins (Figure 1a). The epandrial complex was subsequently removed from the protandrial segment under a Leica S8APO stereomicroscope and examined without maceration. Photographs were taken with a Leica DFC 450 camera mounted on a Leica M125 stereomicroscope, and series of photographs with different focal depths were stacked by Helicon Focus Pro version 7.5.4 (Helicon Soft Ltd, Kharkiv, Ukraine) to obtain a composite image. SEM images of gold-coated terminalia were taken with a FEI Quanta 450 FEG scanning electron microscope (Thermo Fisher Scientific, Waltham, MA, USA) at the Science and Technology Application and Research Centre of Yozgat Bozok University (BILTEM). The extracted terminalia were stored in glycerine contained in a microvial pinned beneath the specimen.

Identification was done using Böttcher (1912) and Lehrer (1994); nomenclature follows Krčmar et al. (2019); terminology of external morphology and terminal structures follow Whitmore et al. (2018); synonymy and distribution follow Pape (1996), Lehrer (2006) and Xue et al. (2011).

## Results

### *Sarcophaga (Latistyla) czernyi* Böttcher, 1912

*Sarcophaga czernyi* Böttcher, 1912: 731. Syntypes, two males: Croatia, Dalmatia, Dubrovnik (as "Ragusa"), in Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany.

*Parasarcophaga paularnaudi* Lehrer, 1981: 185. Lebanon, 70 miles SE of Beirut, Koura (as "El Coura"), Bterram. Holotype male: California Academy of Sciences, San Francisco, USA.

Chresonyms. *Thyrsocnema czernyi* Enderlein 1928: 43; *Parasarcophaga* (?*Rosellea*) *czernyi* Rohdendorf, 1937: 246-247; *Sarcophaga czernyi* Séguy, 1941: 96; *Parasarcophaga (Latistyla) czernyi* Strukan, 1970: 96; *Parasarcophaga (Rosellea) czernyi* Verves, 1986: 172; *Rosellea czernyi* Verves, 1990: 542; *Sarcophaga (Macabiella) czernyi* Pape, 1996: 360; *Latistyla czernyi* Xue et al., 2011: 314; *Sarcophaga (Latistyla) czernyi* Krčmar et al., 2019: 134; *Parasarcophaga (Rosellea) paularnaudi* Verves, 1986: 172; *Macabiella paularnaudi* Lehrer, 1994: 15; 1998: 43; 2006: 18; *Rosellea paularnaudi* Verves, 1990: 542.

### Description

Male. Body length: 12.7 mm.

Head. Eye bare, red. Parafacial plate and fronto orbital plate black, with silvery pollinosity. Frontal vitta dark gray. Frontal bristles nine pairs, stronger anteriorly. Fronto orbital plate with dispersed short and black setulae. Occiput densely gray pollinose. Antennae black, postpedicel with brownish pollinosity. Arista brown, thickened on basal 2/3, plumose. Postpedicel 3.51 times as long as pedicel. Frons narrow, at vertex 0.25 times, at level of antennal base 0.35 times as wide as head, and at narrowest point 0.57 times as wide as an eye in dorsal view. Frontal vitta 0.45 times as wide as frons and slightly widening anteriorly to antennal insertion. Width of parafacial plate at level of antennal base 0.51 and gena 0.32 times eye height. Gena with dispersed short and black setulae slightly longer towards posterior half. Postgenal setae long and blonde. Vibrissa stout. Lower facial margin hardly visible in lateral view. Two rows of black postoccipital setae. Inner vertical seta long and strong, outer vertical seta absent. Ocellar bristles of medium length. One pair of reclinate fronto orbital setae. A row of erect bristles along facial ridge. Palpus and prementum brownish.

Thorax. Black with silvery pollinosity and three dorsal longitudinal black stripes. The median one reaching to scutellum. Chaetotaxy: acrostichals 0+1, dorsocentrals 4-5+4, intraalars 0+2, supraalars 3, posthumeral 2, notopleurals 4 (2 primer+2 subprimer), katepisternals 3, postalar wall setulose, propleuron bare, scutellum with one pair of basal and two pairs of subapical setae.

Legs. Black. All femora with a row of distinct and long bristly setae on dorsal and ventral surfaces and with hair-like setae. Hind femur with a row of strong anteroventral setae. Mid tibia with three posteroventral and one anterodorsal, hind tibia with two posterodorsal and 1 anterodorsal setae, and with ventral villosity. All tarsi as long as tibiae. Pretarsus slightly swollen towards the tip (Figure 1a).

Wing. Hyaline. Costal spine absent. Tegula black. Basicosta yellow. Cell  $r_{4+5}$  open at wing margin. Wing vein  $R_1$  bare.  $R_{4+5}$  with short setulae at base. M right-angled. Cross vein dm-cu nearly straight. Second costal section 1.4 times as long as fourth costal section. Calypter whitish. Halter brownish yellow (Figure 1b).

Abdomen. Black in ground color with gray pollinosity and silvery checkered pattern. Protandrial segment black with gray pollinosity. Syntergite 1+2 and tergite 3 without median marginals. Tergite 4 with a pair of median marginals. Tergite 5 with a complete row of marginal bristles.

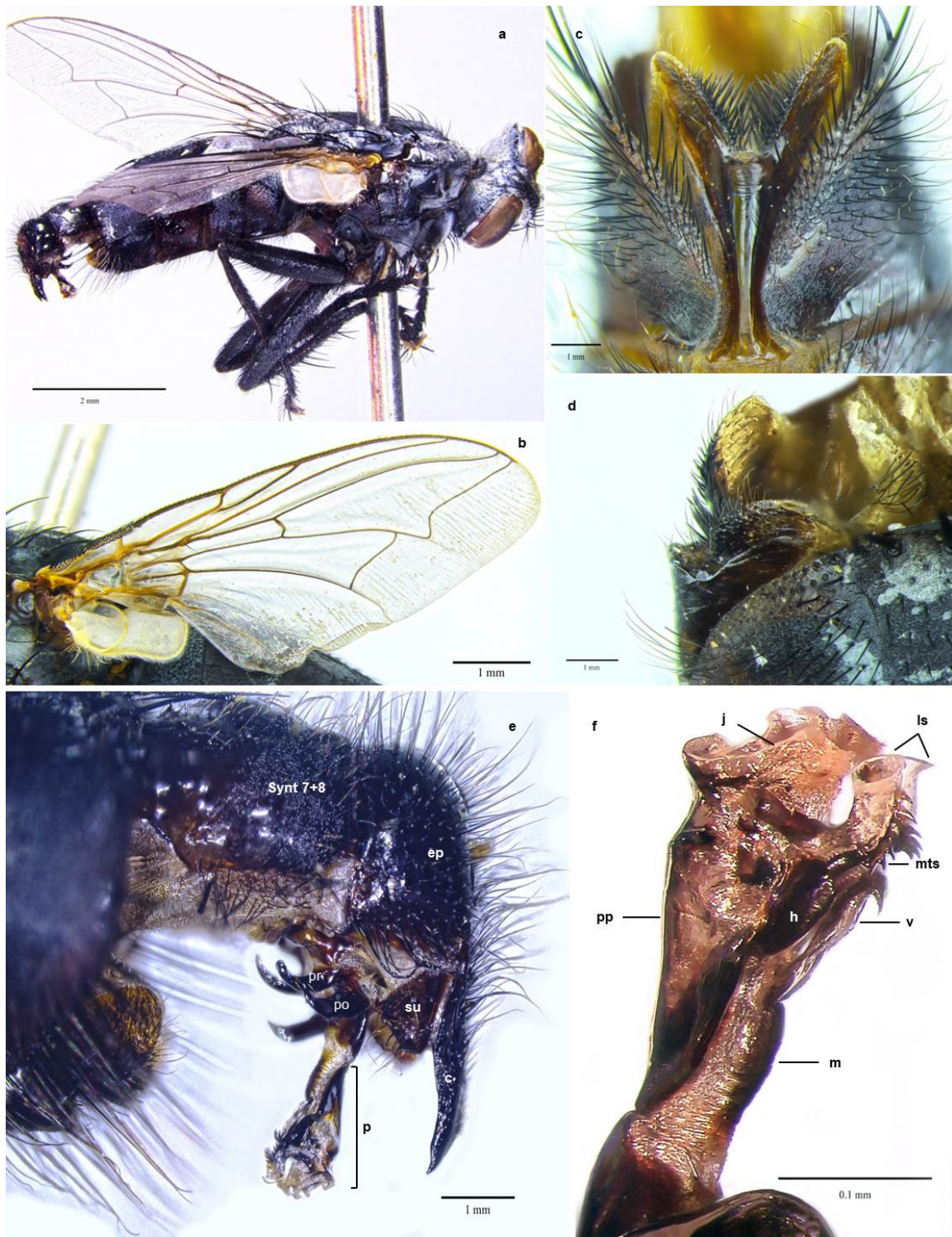


Figure 1. Male of *Sarcophaga (Latistyla) czernyi* Böttcher, 1912: a) habitus, right lateral view; b) wing, ventral view; c) abdominal sternite 5, ventral view; d) abdominal sternite 5, left lateral view flipped vertically; e) terminalia, right lateral view; and f) phallus, right lateral view, flipped vertically. Abbreviations: c, cercus; ep, epandrium; h, harpes; j, juxta; ls, lateral stylus; m, membrane; mts, marginal teeth of stylus; p, phallus; po, postgonite; pp, paraphallus; pr, pregonite; su, surstylus; Synt 7+8, syntergite 7+8; and v, vesica.

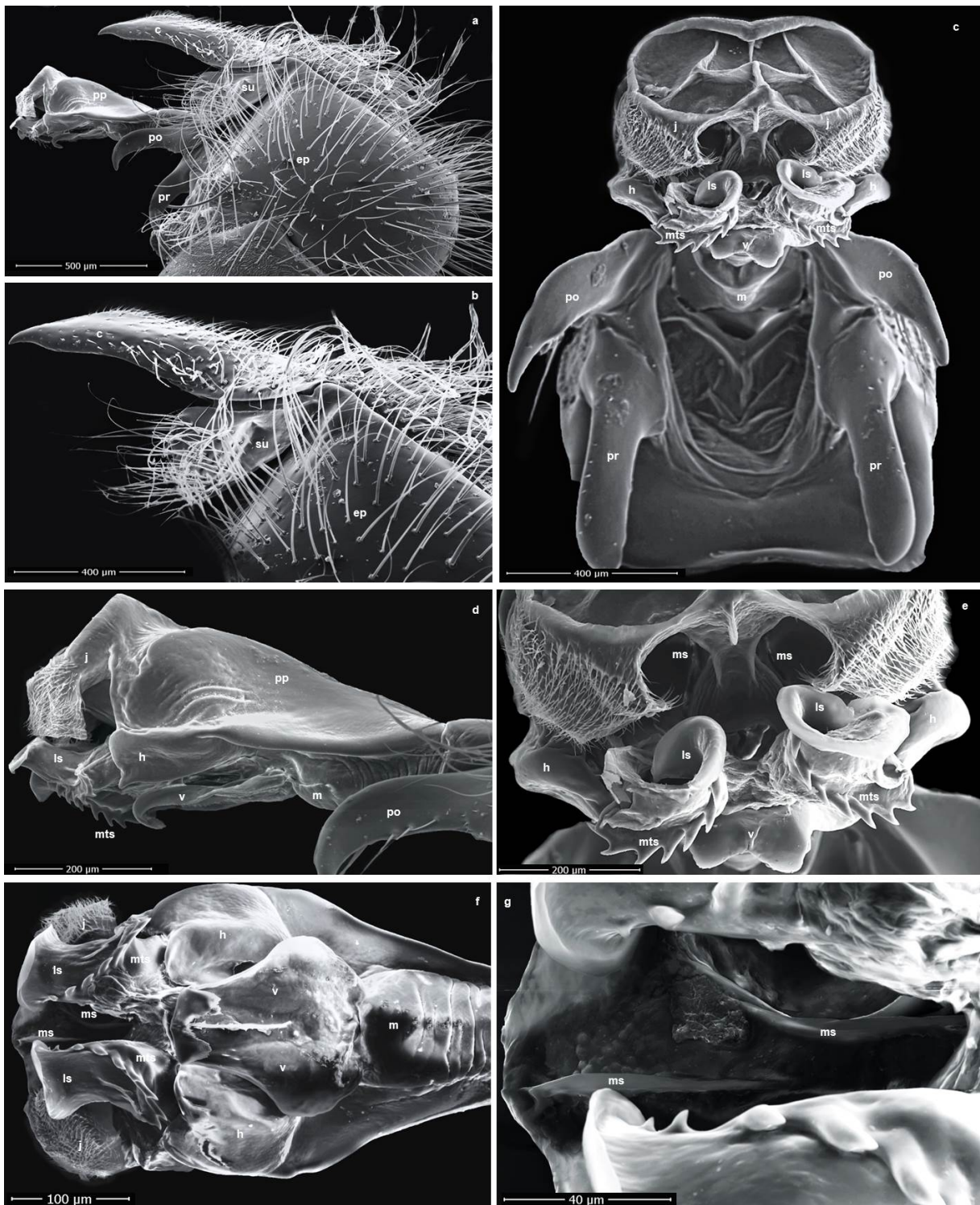


Figure 2. Ultrastructure of male terminalia of *Sarcophaga (Latistyla) czernyi* Böttcher, 1912: a) terminalia, left lateral view; b) cercus and surstylus left lateral view; c) distiphallus and gonites, apical view; d) distiphallus, left lateral view; e) lateral styli and vesica, apical view; f) distiphallus, ventral view; and g) median stylus, ventral view. Abbreviations: c, cercus; ep, epandrium; h, harpes; j, juxta; ls, lateral stylus; m, membrane; ms, median stylus; mts, marginal teeth of styli; po, postgonite; pp, paraphallus; pr, pregonite; su, surstylus; and v, vesica.

Terminalia. Sternite 5 Y-shaped, basal part straight with a sharply protruding longitudinal keel in lateral view, each arm with short and thick inner median setae (Figure 1c-d). Syntergosternite 7+8 not extended and without marginal bristles, only with scattered and weak setulae on dorsal surface (Figure 1e). Epandrium shiny black, subrectangular. Cerci black, cercal prongs deeply carved beyond midline in dorsal view, concave in profile, convex at the edges and slightly notched at apex, on posterior surface with a slightly protruding longitudinal groove. Surstyli dark brown, robust and subtriangular with a tuft of dense and long setae apically (Figures 1e, 2a-b). Gonites dark brown, similar in shape, slightly curved in outline, blunt at the tip. Pregonites a bit longer than postgonites (Figures 1e, 2a-d). Phallus dark brown. Basiphallus shortened and about 1/2 length of distiphallus. Distiphallus broader in lateral view (Figures 1e, 2a-d). Juxta composed of two membranous lobes fused into a single and rounded wide plate in profile, with numerous microtrichia on apical half; perpendicular to longitudinal axis of distiphallus and curved inwards (Figures 1f, 2c-d, f). The distal part of paraphallus not articulated with the basal part and shown only by a pair of long, wide sclerites in lateral view. Vesica well developed, welded into a plate with two vertices curved ventrally, hook-like (Figures 1f, 2c-f). Harpes flattened and slightly subrectangular, with rounded edges and notched apicoventrally in lateral view. Lateral styli very large and tubular, with strong and well-sclerotized marginal teeth (Figures 1f, 2c-f). Median styli filamentous, not protruding beyond juxta (Figure 2e-g).

Female. Unknown.

Distribution. Palearctic-Croatia, Greece, Israel, Lebanon, Turkey (Pape, 1996; Lehrer, 2006; Xue et al., 2011; Krčmar et al., 2019;).

Biology. Unknown.

## Discussion

When Böttcher (1912) described *Sarcophaga czernyi*, he observed that the general shape of the phallus was reminiscent of different types of the *aratrix* and *tuberosa* groups. Rohdendorf (1937) erected the subgenus *Rosellea* and also mentioned that various appendages of the phallus of *czernyi* showed affinities to *aratrix* (*Rosellea*) and *tuberosa* (*Liosarcophaga*). Particular characteristics were the paired appendages (= membranous processes; in that paper styli used instead), directed distally and covered with numerous denticles along their anterior margin. However, Rohdendorf likened the right-angled juxta to *S. (Robineauella) caerulescens* Zetterstedt, 1838 (as *S. scoparia* Pandellé, 1896). Eventually, he tentatively placed it into *Parasarcophaga* (?*Rosellea*), pointing out that this species was unknown to him and possibly it was a representative of a new, yet undescribed subgenus, as indicated by its distinct structure of the membranal processes of distiphallus.

Enderlein (1928) assigned *S. czernyi* to the genus *Thyrsocnema*. Séguy (1941) followed Böttcher's classification of a broad *Sarcophaga* without subgenera. Strukan (1970) was the first author to describe a new subgenus (*Latistyla*, placed within *Parasarcophaga* Johnston & Tiegs, 1921) specifically designating *S. czernyi* as type species. Lehrer (1981) described *Parasarcophaga paularnaudi* Lehrer, 1981 based on a male from Lebanon, with detailed illustration of the phallus. Verves (1986) accepted *paularnaudi* and *czernyi* as separate species and introduced an affiliation within *Parasarcophaga* (*Rosellea*). In the early classifications, *Parasarcophaga* was a quite large and heterogeneous genus of Sarcophaginae, and many subdivisions into subgenera were used by some authors (Rohdendorf, 1937, 1965; Verves, 1986). Contrarily, Pape (1987) preferred to keep the species as *aratrix* (Pandellé, 1896), *uliginosa* (Kramer, 1908), *caerulescens* Zetterstedt, 1838 and *Liosarcophaga* spp. solely in *Parasarcophaga* for the Danish and Fennoscandian species.

Lehrer (1994) erected *Macabiella* as an independent genus and assigned *P. paularnaudi* as type species. This species was synonymized with *czernyi* by Pape (1996), who placed it in *Sarcophaga*, subgenus *Macabiella*.

Lastly, Xue et al. (2011) synonymized *Macabiella* Lehrer, 1994 with *Latistyla* Strukan, 1970 and placed *L. czernyi* and *L. paularnaudi* in the subtribe Boettcheriscina. Krčmar et al. (2019) listed the species as *Sarcophaga* (*Latistyla*) *czernyi* in their checklist of Croatian flesh flies.

Although the holotype of *L. paularnaudi* (Lehrer, 1994) could not be examined in the present study, it is conclusively seen that the original description of Lehrer (1994, p. 15, Figure 1b) is in line with the data presented here and in previous studies (Böttcher, 1912; Rohdendorf, 1937). The localities of the collected specimens are bordering the Mediterranean Sea, and the geographical and morphological affinities of these two nominal species strengthen their synonymy. Consequently, in the present study *L. paularnaudi* is accepted as a synonym of *S. (L.) czernyi* as proposed by Pape (1996).

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