



New records of *Sarcophaga* Meigen (Diptera: Sarcophagidae: Sarcophaginae) for the Northeast region of Brazil

Novos registros de *Sarcophaga* Meigen (Diptera: Sarcophagidae: Sarcophaginae) para a região Nordeste do Brasil

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With the aim of reducing the gap in the knowledge on the Sarcophagidae fauna that occurring in the Northeast region of Brazil, the present work reports the unheard occurrence of two species of the genus *Sarcophaga* Meigen, 1826 in Bahia. The specimens were sampled in the urban area of the Salvador municipality (Bahia State, Brazil), through two collecting methods: traps using human feces as baits [adapted from the model proposed by Ferreira (1978)], and active sweep with entomological net. The present study brings the first record of *Sarcophaga* (*Bercaea*) *africa* for the Brazilian Northeast region and the first record of *Sarcophaga* (*Liopygia*) *ruficornis* for Bahia State.

Keywords: flesh fly, forensic entomology, Neotropical Region.

Com o objetivo de reduzir a lacuna no conhecimento sobre a fauna de Sarcophagidae que ocorre na região Nordeste do Brasil, o presente trabalho relata a ocorrência inédita de duas espécies do gênero *Sarcophaga* Meigen, 1826 na Bahia. Os espécimes foram amostrados na zona urbana do município do Salvador (Estado da Bahia, Brasil), através de dois métodos de coleta: armadilhas usando fezes humanas como iscas [adaptadas do modelo proposto por Ferreira (1978)], e varredura ativa com rede entomológica. O presente estudo relata o primeiro registro de *Sarcophaga* (*Bercaea*) *africa* para a região Nordeste do Brasil e o primeiro registro de ocorrência de *Sarcophaga* (*Liopygia*) *ruficornis* para o estado da Bahia.

Palavras-chave: mosca da carne, entomologia forense, Região Neotropical.

1. INTRODUCTION

The family Sarcophagidae (Insecta: Diptera) is the second most diverse group among the dipterans of the superfamily Oestroidea, second only to Tachinidae [1, 2]. Sarcophagids are widely distributed across the planet, with the exception of the Arctic and Antarctic regions and present greater diversities in warm climate regions [3, 4]. The flies of this family are commonly known as "flesh flies" and currently comprise approximately 400 genera and more than 3,100 species distributed worldwide. Of these species, about 800 have been recorded in Neotropical regions, with approximately 370 species occurring in Brazil [1, 3, 5, 6]. Three subfamilies are recognized for Sarcophagidae: Miltogramminae, Paramacronychiinae and Sarcophaginae, which are composed of individuals with different life habits, such as: kleptoparasites, parasitoids, predators, saprophagous, necrophagous, coprophages, as well as causing myiasis in vertebrates [7].

One of the particularities of this family is its ovoviviparous biology (at least for the vast majority of species - see Bordas et al. (2007) [8] and Pimslér et al. (2014) [9]), the female sarcophagids deposit first instar larvae on the colonization substrate and, this characteristic can

enable pioneering in the colonization of the substrate [10, 11]. Of the substrates used by sarcophagids, their role in colonizing decomposing non-human vertebrate carcasses [e.g. 12-17], as well as human corpses, should be noted [e.g. 10, 18-23]. Thus, due to these characteristics sarcophagids are considered an important tool for Forensic Entomology and are mainly used to help determine time of death (Post-Mortem Interval - PMI) [5, 10, 11, 13, 17, 24, 25]. Additionally, the ability of some species to cause facultative myiasis in humans also represents an important tool for authorities during their investigations of suspected mistreatment and neglect to incapable. According to Grassberger (2002) [26], these insects are attracted by the smell of necrotic tissue from an injured area, blood, urine and the feces of the incapable person, who are commonly children, elderly and/or people with special needs.

The genus *Sarcophaga* Meigen, 1826, an important genus of flesh flies, is distributed worldwide, with a greater specific richness in the Old World. Currently, it is comprised of about 890 valid species, grouped into 169 subgenera [3, 27]. For the Neotropical region, only 23 species are reported [3]. In Brazil, according to the proposal by Mello-Patiu and Santos (2022) [28], there are six species of *Sarcophaga* distributed across four subgenera: *Sarcophaga (Bercaea) africa* (Wiedemann, 1824), *S. (Liopygia) argyrostoma* (Robineau-Desvoidy, 1830), *S. (L.) crassipalpis* Macquart, 1839, *S. (L.) ruficornis* (Fabricius, 1794), *Sarcophaga (Liosarcophaga) sarracenides* Aldrich, 1916, and *Sarcophaga (Neobellieria) polistensis* (Hall, 1933). *Sarcophaga* species are widely recorded colonizing cadavers [19-21, 29-31], as well as causing myiasis in humans [32-37], and are therefore considered important tools for forensic and medical entomology, respectively.

Despite the veterinary (myiasis in domestic animals), medical (myiasis in humans and potential microscopic pathogen vectors), and forensic (participation in cadaveric decomposition) importance of sarcophagids, studies about these fauna are mainly concentrated in the Northern, Southern and Southeastern regions of Brazil [3, 38]. Therefore, little is known about this fauna in other regions, especially the Northeastern region of the country [11]. Many factors contribute to the difficulty of gathering knowledge on sarcophagids in other regions of the country, especially in the Northeast such as: the great species richness of this group, the taxonomic difficulties in recognizing these dipterans at the species level, the lack of taxonomic reference collections, lack of adequate literature and, above all, the reduced number of taxonomists specializing in Sarcophagidae, often prevents and/or discourages research on this important family of flies [11, 16].

In order to reduce the gap in knowledge on the Sarcophagidae fauna that occurs in the Northeastern region of Brazil, the present study reports the first record of two species of the genus *Sarcophaga*: *S. (Bercaea) africa* (Wiedemann, 1824) and *S. (Liopygia) ruficornis* (Fabricius, 1794), representing the first record in the Northeast region and in state of Bahia, respectively.

2. MATERIAL AND METHODS

The collection of specimens representing *Sarcophaga (Bercaea) africa* and *Sarcophaga (Liopygia) ruficornis* took place in the urban area of the municipality of Salvador, State of Bahia (neighborhood Calabetão - 12°55'52.8"S/38°28'10.6"W), Brazil [permanent collection license number 16777, granted by the Sistema de Autorização e Informação em Biodiversidade (SISBIO), of the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Ministério do Meio Ambiente (MMA), Brazil], using two collection methods. The first method involved the use of traps containing human feces as bait to attract insects (trap adapted from Ferreira (1978) [39]). The traps were exposed for 72 hours per month during all the year 2016, with the baits being replaced every 24 hours. The second collection method involved a single active search/scan, which was performed in the vegetation, carried out on 12.ix.2021. The observed specimens were captured with an entomological net, transferred to a deadly chamber and anesthetized by ethyl acetate.

All the collected insects were sent to the Laboratório de Bionomia, Biogeografia e Sistemática de Insetos (BIOSIS) of the Instituto de Biologia (IBIO) of the Universidade Federal

da Bahia (UFBA), where they were mounted on entomological pins. To prepare the specimens, the male phallus was externalized with the aid of an entomological pin and, subsequently, the specimens were dried in a drying oven. They were identified using the taxonomic key provided by Carvalho and Mello-Patiu (2008) [5] and Vairo et al. (2011) [40], and identifications were later confirmed by an expert taxonomist of this group (one of the authors). Following identification, the specimens were deposited in the Entomological Collection of the Zoology Sector of the Museu de História Natural da Bahia (MHNBA-Zoo/UFBA). For the morphological study and specimen photography, a Leica M165C stereoscopic microscope was used, coupled with a Leica DFC295 digital camera, containing the Leica Application Suite V4.1 Interactive Measurements Software, Montage. To make the species distribution map we used the geographic coordinates of the state capitals for which previous occurrence records were available in the scientific literature, except when the exact location of collection was provided. The map was created using Qgis software.

3. RESULTS AND DISCUSSION

In the experiments using human feces as traps baited, were sampled 748 male specimens of the Sarcophagidae family, of which five individuals were identified as belonging to the species *Sarcophaga (Bercaea) africa* (Wiedemann, 1824) (Figure 1A-B) (Vouchers MHNBA: MZUFBA-Diptera 00970 – 00974). Among the specimens sampled through the active sweep of the vegetation, only one specimen belonging to the species *Sarcophaga (Liopygia) ruficornis* (Fabricius, 1794) was identified (Figure 2A-B) (Voucher MHNBA: MZUFBA-Diptera 00975). According to Carvalho and Mello-Patiu (2008) [5] and Vairo et al. (2011) [40], *S. (B.) africa* is identified using the following set of morphological characters: phallus with small basiphallus, distiphallus with an anteriorly oriented conspicuous juxta, vesica slightly concave (Figure 1A) and silvery gena microtomentose (Figure 1B). The characters used to identify *S. (L.) ruficornis* are: antenna with yellowish or orange first flagellomere (Figure 2B) and phallus, as shown in figure 67 by Carvalho and Mello-Patiu (2008) [5] (Figure 2A).

In Brazil, *S. (B.) africa* has been recorded to occur in the Southeastern (Rio de Janeiro) and Southern (Paraná and Rio Grande do Sul) regions [3, 6, 7, 40, 41] therefore, here we present the first record of this species in the Northeastern region of Brazil (Figure 3). *Sarcophaga (L.) ruficornis*, has records to Southeastern (Rio de Janeiro and São Paulo), Northern (Pará) and Northeastern (Pernambuco and Rio Grande do Norte) regions of Brazil [3, 7, 19, 20, 32, 33, 41-46] thus, we report this species for the first time to the State of Bahia, expanding its distribution in Northeastern Brazil (Figure 3).

The new reports of *S. (B.) africa* and *S. (L.) ruficornis* for the Northeastern region and for the state of Bahia are quite relevant, especially due to the fact that both species have been found to colonize cadavers and cause myiasis in humans. *Sarcophaga (L.) ruficornis* has been reported to cause myiasis in humans in Thailand [34], India [35] and Brazil (Rio de Janeiro [32] and Rio Grande do Norte [33]), in addition to colonizing human cadavers in Thailand [29], Malaysia [30] and Brazil (Rio de Janeiro) [19, 20]. *Sarcophaga (B.) africa* has been reported to cause myiasis in humans in Italy [36, 37] and to colonize human cadavers in Switzerland [21] and Iran [31]. Therefore, it is likely that these species are also capable of colonizing cadavers and causing myiasis in humans in Bahia.

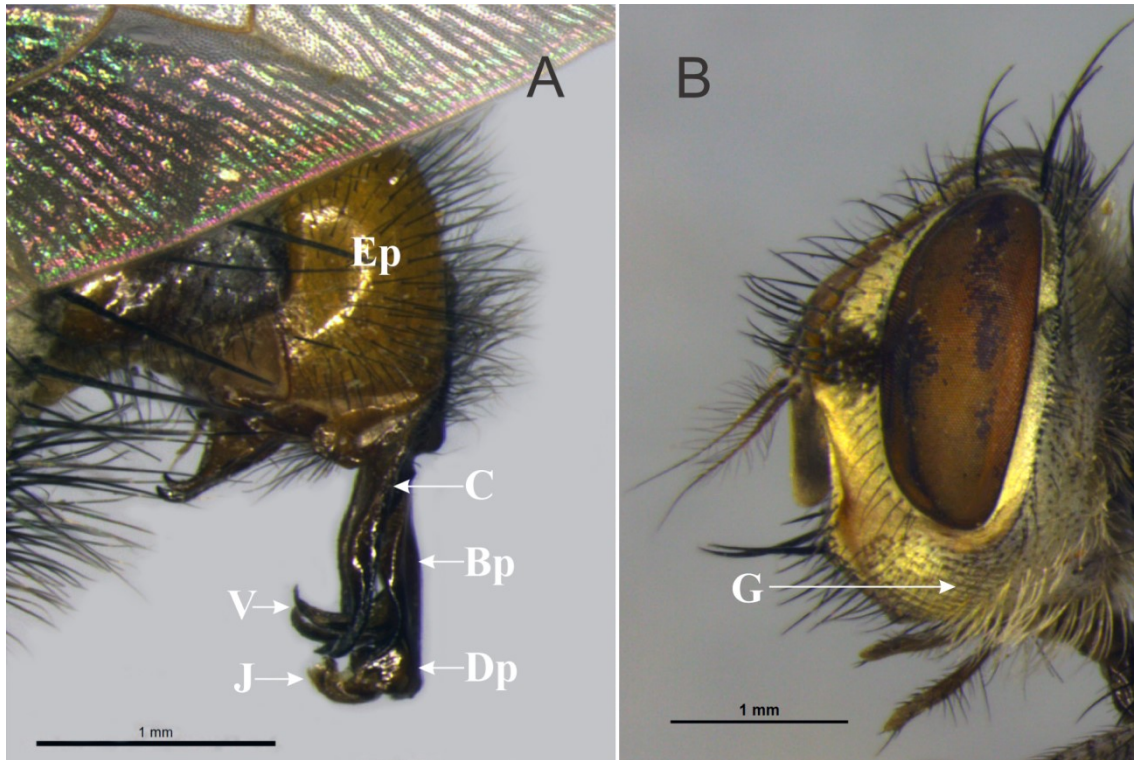


Figure 1A-B: Terminalia and head of *Sarcophaga (Bercaea) africa* (Wiedemann, 1824) in lateral view, respectively. Abbreviations: Ep: epandrium, C: cercus, Bp: basiphallus, Dp: distiphallus, V: vesica, J: juxta, G: gena.

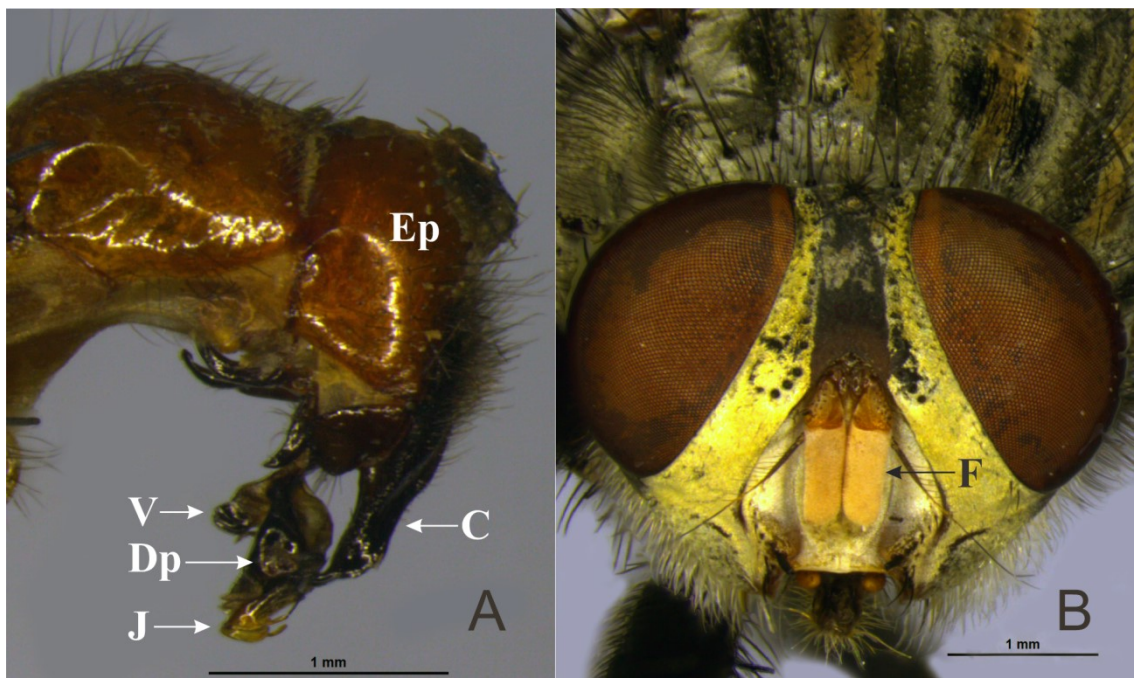


Figure 2A-B: Terminalia in lateral view and head in frontal view of *Sarcophaga (Liopygia) ruficornis* (Fabricius, 1794), respectively. Abbreviations: Ep: epandrium, C: cercus, V: vesica, Dp: distiphallus, J: juxta, F: first flagellomere.

It is important to note that the bionomic data for estimating the PMI, mainly using data from *S. (B.) africa*, should be used with caution, since according to Bänzinger and Pape (2004) [47],

this species prefers to use feces as a substrate for larviposition, rather than cadaveric tissue. Thus, our results corroborate, to a certain extent, the study carried out by Bänzinger and Pape (2004) [47], since we sampled this species in traps baited with human feces. However, in addition to the feeding habits of the species, other variables are need to considered in order to correctly estimate the PMI, such as the effect of chemical substances on the larval development of the species. For example, Goff et al. (1992, 1997) [48, 49] noted that methamphetamine at high concentrations accelerated development and that 3,4-methylenedioxyamphetamine, even at low concentrations, retarded the larval development of *S. (L.) ruficornis*. Goff et al. (1991, 1993) [50, 51] and Ren et al. (2018) [52] emphasized the need for more in-depth studies on the effects of different drugs on the larval development of necrophagous insects. Although we agree with these authors, we also emphasize the need for integrative taxonomic studies, which permit the safe identification of insects that comprise cadaveric fauna, since the correct identification of necrophagous insects is, without a doubt, the most important data for forensic entomology. The correct identification of species allows for the elaboration of more varied studies, between them studies of bionomy and biology, especially for Sarcophagidae, since there are still large gaps regarding the knowledge of its fauna.

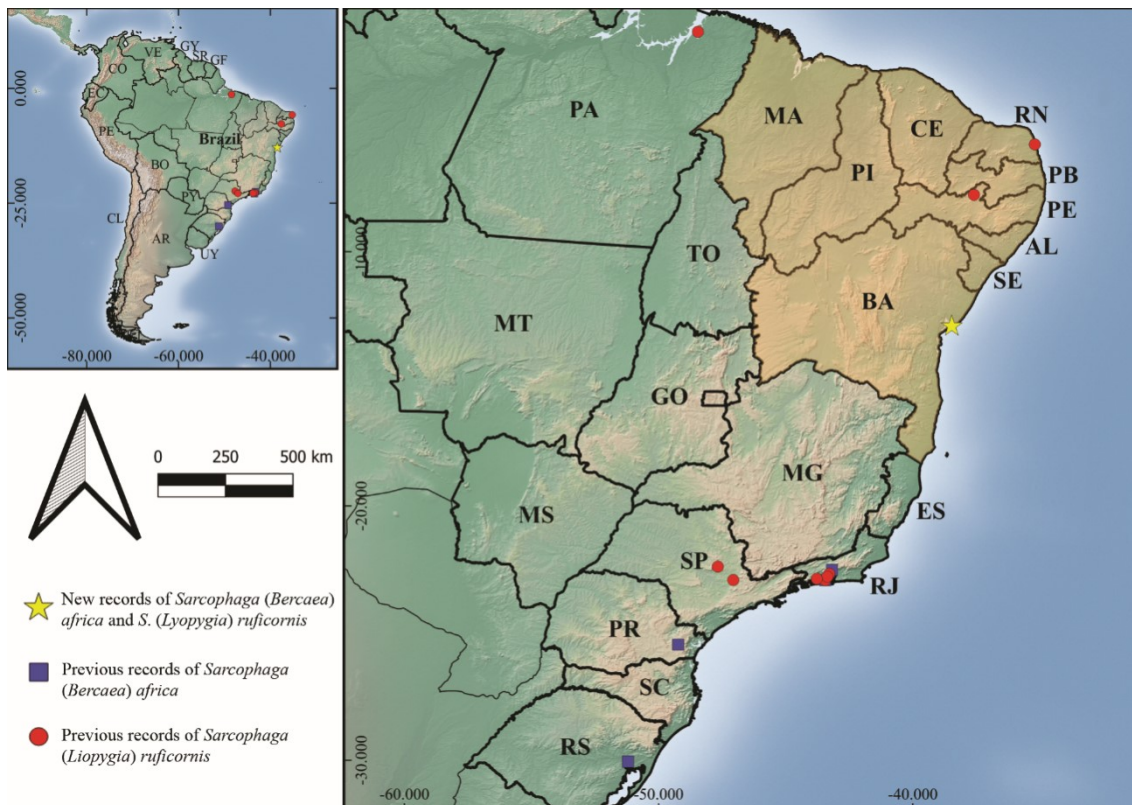


Figure 3: Geographic distribution of *Sarcophaga (Bercaea) africa* (Wiedemann, 1824) and *Sarcophaga (Liopygia) ruficornis* (Fabricius, 1794) in Brazilian. Northeastern region featured (translucent yellow).

4. CONCLUSION

The present study provides the first record of *Sarcophaga (Bercaea) africa* in the Northeastern region of Brazil and of *Sarcophaga (Liopygia) ruficornis* in the state of Bahia, expanding the geographic distribution for both species in Northeastern Brazil. These records are of great relevance to forensic and medical sciences, given that these species recorded here comprise cadaveric fauna, colonizing corpses and causing myiasis in humans. Additionally, we emphasize the need to carry out more studies like this, as they are fundamental for expanding our knowledge about the species that occur in a certain region, contributing to the reduction of the Wallacean deficit. Farther, they provide very useful information that can be favorable to

society, for example in criminal investigations, in the fight against violent crimes, mistreatment and neglect or in public health policies.

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