New records of calyptrate dipterans (Fanniidae, Muscidae and Sarcophagidae) associated with the decomposition of domestic pigs in Brazil

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*The calyptrate dipterans are the most important decomposers of human cadavers. Knowledge of their species and distribution are of great importance to forensic entomology, especially because of the enormous diversity in Brazil. Carcasses of domestic pigs (*Sus scrofa*, L) were the experimental models used to attract calyptrates of forensic interest during the winters of 2006 and 2007 and the summers of 2006 and 2008. A total of 24,423 specimens from 44 species were collected (19 Muscidae, 2 Fanniidae and 23 Sarcophagidae), three of which were new records of occurrence and 20 of which were new forensic records for the state of Rio de Janeiro. Fourteen of these species were newly identified as forensically important in Brazil.*

Key words: forensic entomology - carcasses - calyptrate dipterans - Rio de Janeiro

Dipterans are the main insects involved in the decomposition of human cadavers and animal carcasses when exposed to open environments (Keh 1985, Smith 1986, Catts & Haskell 1991, Oliveira-Costa 2008). Some of them use organic matter of animal origin for the development of their immature forms (Souza & Linhares 1997). This behaviour of these insects is of great importance in forensic entomology because the developmental period of the immature forms is used as a basis for calculating the *post-mortem* interval (Greenberg 1991, Oliveira-Costa & Mello-Patiu 2004).

Many species of calyptrate dipterans use carcasses of animals and human corpses to obtain protein for ovarian development or as a mating site (Smith 1986, Souza & Linhares 1997, Carvalho et al. 2000). Therefore, it is necessary to know the species involved in the decomposition of animal carcasses and their geographical distribution.

In Brazil, there are few studies listing fly species associated with animal decomposition. Difficulties in identifying necrophagous calyptrate dipterans and the lack of taxonomic experts have become barriers in relation to this matter. Thus, the purpose of this study was to identify the species of calyptrate dipterans of the families Muscidae, Sarcophagidae and Fanniidae involved in the decomposition process of domestic pig carcasses in the city of Rio de Janeiro.

Financial support: PAPES V, CNPq
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Received 13 April 2009
Accepted 22 July 2009

The experiment was carried out on the Fiocruz campus (22º51'06''S 43º14'27''W) in the metropolitan area of Rio de Janeiro. Three areas with distinct physiographic characteristics were chosen for the experiments, each different from the other in terms of luminosity, vegetation and movement of people. One domestic pig carcass (*Sus scrofa* Linnaeus, 1758) weighing approximately 15 kg was used in each area to attract the insects. The pigs were sacrificed with a blow to the head and immediately placed inside the traps. These traps were composed of a metal, pyramid-shaped structure covered with a black cotton cloth, with a strip of white nylon along its lower rim for luminosity and ventilation. At the top of the pyramid, there was an insect pipe collector with a central window made of thin nylon to allow air and light into the pipe (Figure). The flies trapped inside the pipe were taken to the laboratory where they were identified at the family level and frozen at -17ºC.

Identification keys were used to segregate the species according to Carvalho and Couri (2002), Carvalho et al. (2002), Couri and Carvalho (2002), Couri (2005) and Carvalho and Mello-Patiu (2008). The collections were carried out daily during four distinct periods: January 25, 2006-February 22, 2006 (summer), August 29, 2006-September 21, 2006 (winter), August 15, 2007-August 27, 2007 (winter) and January 16, 2008-January 30, 2008 (summer). Muscids were collected and identified in all four experiments, while fanniids and sarcophagids were identified only in the two experiments during 2007 and 2008. In the present analysis, we considered that a species had a forensic record when it was caught in association with either human corpses or domestic pig carcasses (Oliveira-Costa 2008).

A total of 24,423 specimens from 44 species (19 Muscidae, 2 Fanniidae and 23 Sarcophagidae) were collected. Table shows the species list and highlights the new records of occurrence: new forensic records for Bra-

TABLE

Absolute abundance, records of occurrence and forensic records of the species associated with the decomposition of domestic pigs in Brazil and in the state of Rio de Janeiro

	Winter		Summer					
Species	2006	2007	2006	2008	n	NRORJ	NFRRJ	NFRBr
Muscidae								
Atherigona orientalis Schiner, 1868	x	x	x	x	7,310			
Biopyrellia bipuncta (Wiedemann, 1830)			x		2		x	
Brontaea normata (Bigot, 1885)	x	x	x	x	195		x	x
Brontaea sp.	x		x		26		x	x
Cyrtoneurina sp.	x		x		20		x	
Cyrtoneuropsis conspersa (Stein, 1911)				x	2	x	x	x
Graphomya maculata (Scopoli, 1763)	x	x	x	x	221	x	x	x
Limnophora deleta (Wulp, 1896)				x	28	x	x	x
Morelia couriae Pamplona, 1986			x		4			
Morelia humeralis (Stein, 1918)		x			2		x	
Morelia ochricornis Wiedemann, 1830	x	x	x	x	59		x	x
Musca domestica Linnaeus, 1758	x	x	x	x	225			
Myospila pallidicornis (Bigot, 1887)	x		x		93		x	x
Neomuscina sp. 1	x		x		3		x	x
Neomuscina sp. 2				x	21		x	x
Ophyra aenescens (Wiedemann, 1830)	x	x	x	x	6,063			
Ophyra albuquerquei Lopes, 1985	x	x	x	x	37		x	
Ophyra chalcogaster (Wiedemann, 1824)	x	x	x	x	1,002			
Synthesiomyia nudiseta (Wulp, 1883)	x	x	x	x	3,736			
Fanniidae								
Fannia pusio (Wiedemann, 1830)		x		x	3,114			
Fannia flavicincta (Stein, 1904)		x		x	108		x	x
Sarcophagidae								
Helicobia aurescens Townsend, 1927		x		x	7		x	
Helicobia pilipleura Lopes, 1939		x			5		x	x
Oxysarcodexia amorosa (Schiner, 1868)		x		x	130			
Oxysarcodexia avuncula (Lopes, 1933)		x		x	5			
Oxysarcodexia diana (Lopes, 1933)		x		x	132			
Oxysarcodexia fluminensis Lopes, 1946		x		x	200			
Oxysarcodexia intona (Curran & Walley, 1934)		x		x	13			
Oxysarcodexia modesta Lopes, 1946		x			1			
Oxysarcodexia parva Lopes, 1946		x		x	6			
Oxysarcodexia simplicoides (Lopes, 1933)		x		x	14		x	x
Oxysarcodexia thornax (Walker, 1849)		x		x	573			
Oxysarcodexia timida (Aldrich, 1916)		x		x	93			
Oxysarcodexia xanthosoma Aldrich, 1916		x		x	4		x	x
Peckia (*Euboettcheria*) *collusor* (Curran & Walley, 1934)		x		x	18			
Peckia (*Pattonella*) *intermutans* (Thomson, 1869)		x		x	17			
Peckia (*Peckia*) *chrysostoma* (Wiedemann, 1830)		x		x	68			
Ravinia belforti (Prado & Fonseca, 1932)		x		x	245			
Sarcodexia lambens (Wiedemann, 1830)		x		x	79			
Sarcofahrtiopsis cuneata (Townsend, 1935)		x		x	5		x	x
Sarcophaga (*Bercaea*) *africa* (Wiedemann, 1824)				x	2			
Sarcophaga (*Liopygia*) *ruficornis* (Fabricius, 1794)				x	1			
Tytanogripa (*Cucullomyia*) *larvicida* (Lopes, 1935)		x			1		x	
Tricharea (*Sarcophagula*) *occidua* (Fabricius, 1794)		x		x	533			

n: absolute abundance; NFRBr: new forensic record in Brazil; NFRRJ: new forensic record in state of Rio de Janeiro; NRORJ: new record of occurrence in RJ.

zil and for the state of Rio de Janeiro (RJ). In this study, 14 species were recorded for the first time in association with decomposing domestic pig carcasses in Brazil and 20 for RJ. In addition, three muscid species not listed previously by Couri and Carvalho (2005) were new records for RJ: *Cyrtoneuropsis conspersa* (Stein), *Graphomya maculata* (Scopoli) and *Limnophora deleta* (Wulp).

In pioneer studies carried out by Oliveira-Costa and Lopes (2000) and Oliveira-Costa et al. (2001a, b), also in RJ, *Ophyra aenescens* (Wiedemann), *Musca domestica*

Trap model for capture of the calyptrate dipterans.

Linnaeus and *Synthesiomyia nudiseta* (Wulp) were the only Muscidae species associated with human corpses at a crime scene. However, among the sarcophagids, two species identified in those studies were not found in the present study: *Oxysarcodexia terminalis* (Wiedeman; *Hybopygia terminalis*) and *Oxysarcodexia angrensis* (Lopes). No other forensic entomological study in this region has been published so far.

Other papers listing calyptrate dipterans associated with the decomposition of human and animal carcasses, such as the one compiled by Oliveira-Costa (2008), have also been presented for different Brazilian states. Some species are commonly found in carcasses in different regions of Brazil; among the Muscidae, we can highlight *Ophyra* spp, *S. nudiseta* and *M. domestica* (Monteiro-Filho & Penereiro 1987, Moura et al. 1997, 2005, Carvalho et al. 2000, 2004, Marchiori et al. 2000, Carvalho & Linhares 2001, Souza et al. 2008).

In this work, only two Fanniidae species were collected, but only *Fannia pusio* (Wiedemann) has a forensic record in Brazil (Monteiro-Filho & Penereiro 1987, Carvalho et al. 2000, 2004, Moura et al. 2005, Souza et al. 2008).

The sarcophagids presented the greatest diversity of species in this study. The *Oxysarcodexia*, *Peckia* and *Sarcodexia* species are the most commonly collected in association with decomposing animals (Monteiro-Filho & Penereiro 1987, Moura et al. 1997, 2005, Souza & Linhares 1997, Carvalho et al. 2000, 2004, Carvalho & Linhares 2001, Barros et al. 2008, Carvalho & Mello-Patiu 2008).

The results presented here provide fundamental information concerning the geographical distribution of insect species of forensic importance and for the establishment of a specific data bank for future use in criminal investigations.

ACKNOWLEDGMENTS

To Dra. Márcia Souto Couri, Muscidae and Fanniidae specialist of the Department of Entomology of the Museu Nacional/UFRJ, and to Dr. José Mario d'Almeida, Department of General Biology, Universidade Federal Fluminense, for the great help in identifying some calyptrate dipterans.

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