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A survey of necrophagous blowflies (Diptera: Oestroidea) in the Amazonas-Negro interfluvial region (Brazilian Amazon)

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ABSTRACT

The fauna of blowflies (Calliphoridae and Mesembrinellidae) in three localities of primary Amazon forest coverage in the Amazonas-Negro interfluvial region was assessed. A total of 5066 blowflies were collected, with *Chloroprocta idiodea* being the most abundant species (66.3%). A difference in species richness between the localities ZF2 and Novo Airão was observed. Comparison among sampled sites revealed no considerable variation in fauna composition, except for the species *Eumesembrinella benoisti* (Séguy 1925) and *Hemilucilia* sp., whose occurrence was observed only in a single locality. Apparently, Amazon rivers are not efficient geographical barriers to influence the current composition of necrophagous blowfly assemblages. Also, most of the blowfly species did not show a noticeable specificity for any specific forest among the interfluvial areas of the ombrophilous forest. Finally, an updated checklist of necrophagous blowfly species of the Amazonas state in Brazil is presented.

Introduction

Necrophagous flies of the family Calliphoridae (Diptera: Calyptratae: Oestroidea) are among the first insects to detect, arrive, and colonize animal carcasses in many distinct environments (Hanski, 1987; Amendt et al., 2004). In addition, they have a very important role in the decomposition process (Keh, 1985; Smith, 1986; Catts and Haskell, 1991; Souza and Linhares, 1997; Oliveira-Costa, 2008), and species from this family are of major importance to forensic and medical issues, in the latter for being carriers of many pathological microorganisms (Greenberg, 1971; Amendt et al., 2004; Sawabe et al., 2011). Mesembrinellidae (Diptera: Calyptratae: Oestroidea), a group historically treated as a subfamily of Calliphoridae, appears to have a different biology. The reproductive system of the females is modified; they are viviparous and larvae seem to have parasitoidal preferences. The biology of the immatures is still poorly understood; adults are strongly attracted to dung and carrion, and clearly all species show preferences toward inhabiting pristine forests (Guimarães, 1977).

In forensic and legal matters, knowledge about the distribution and the tolerance to different ecological parameters of these necrophagous species is crucial to infer the locale in which death, or at least the beginning of the decomposition, took place, as well as to estimate the post-mortem interval (PMI) (Greenberg, 1991; Amendt et al., 2004; Oliveira-Costa and Mello-Patiu, 2004; Rocha et al., 2009). Most of this knowledge, however, cannot be easily extrapolated to different localities and the species assemblages usually depend on the degree of conservation of a particular environment (Zabala et al., 2014).

Species in these families have different tolerances to environmental conditions, being affected by the proximity to human populations (synanthropy) and disturbances in primary vegetation coverage, more observable in species of Mesembrinellidae, which are absent in disturbed natural areas and urban environments (Polvony, 1971; Esposito et al., 2010). Also, different blowfly species present distinct dispersal rates and flight capabilities, with environmental elements acting as barriers to some, but not all, species (Macleod and Donnelly, 1960; Tsuda et al., 2009). In the Amazonian rainforest, large rivers constitute one of these barriers, historical or current, to dispersal in different groups of winged animals, such as birds (Hayes and Sewlal, 2004), even though the dynamics of isolated populations may present many other historical causes (Haffer, 1997). Data on flight and dispersal capacity in blowflies is scarce, but the studies conducted so far indicate that they can fly for very long distances; varying in a single flight between 100 and 700 m for *Lucilia* species and from 1250 to 1789 m—and as far as 3500 m/day—for *Calliphora nigribasis* (Tsuda et al., 2009). Moreover, rivers as wide as 182.88 m and slopes as high as 152.40 m do

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not seem to act as barriers to the dispersal of blowflies (Macleod and Donnelly, 1960).

In the Amazonas state (Brazil), the Amazon River and its tributaries, which probably originated circa 5 mya with the uplifting of the Andes (Hoorn et al., 1995; Campbell et al., 2001), were already implicated as historical barriers for dispersal and account for the different distribution of some bird species in the region (Haffer, 1997; Hayes and Sewlal, 2004). For flies, it could also be an important barrier, since in its wider portions the river can be more than 40 km wide during the rainy season. In this context, this study surveyed the blowfly fauna in the interfluvial region of the Amazonas-Negro rivers, with a comparison between the species richness and abundance of the necrophagous fly fauna in the sampled localities.

Material and methods

Van Sommeren-Rydon traps, modified to collect flies, were mounted in three localities of the interfluvial region of the Amazonas-Negro rivers between December 1st and 15th, 2013 (Fig. 1). All localities comprised regions of typical Amazonian rainforest phytophysiognomy with a dense ombrophilous forest according to the classification of IBGE (2012). Sampled localities included: (1) the ZF2 biological reserve, located 50 km from the major urban center in the Manaus municipality; and private properties in the municipalities of (2) Novo Airão and (3) Careiro Castanho. In each locality, 4–7 traps were used, baited with a mixture of decomposing cow, chicken, and fish viscera. Traps were emptied after 2–3 days and all flies collected were counted and identified following the keys provided by Amat et al. (2008), Kosmann et al. (2013), Whitworth (2014), and Wolff et al. (2014).

Data from the different localities were analyzed for relative and total abundance distribution using the IBM-SPSS Statistics (2012) software. Sampling efficiency and representation were assessed using curves for species accumulation, incidence-based coverage estimator (ICE), and the Jack1 and the Chao1 non-parametric estimators of total species richness, using the Estimates 9.0.1 software (Colwell, 2013). Non-parametric Kruskal–Wallis tests and paired Mann–Whitney's *U* tests were used in order to evaluate if there were significant differences in richness and abundance between the localities. The Jaccard coefficient and complementarity index was calculated as a measure of the turnover and complementarity index in species composition between localities (Colwell, 2013). Co-occurrence and spatial assemblage structure were assessed using the *C*-score of Stone and Roberts (1990) using EcoSim software (Entsminger, 2014). Species reported here and a review of literature served to compile the updated checklist.

Results

A total of 6772 dipterans were collected, with Calliphoridae being the most abundant (4356 specimens—64.3%), followed by the families Muscidae (715—10.5%), Mesembrinellidae (710—10.4%), Sarcophagidae (325—4.7%), and Fanniidae (203—2.9%). Other Diptera families comprised 463 individuals (6.8%). Of the 5066 blowfly specimens (Calliphoridae and Mesembrinellidae) collected, 10 were species of Calliphoridae: *Chloroprocta idiodea* (Robineau-Desvoidy, 1830), *Chrysomya albiceps* (Wiedemann, 1819), *Chrysomya megacephala* (Fabricius, 1794), *Chrysomya putoria* (Wiedemann, 1818), *Cochliomyia macellaria* (Fabricius, 1775), *Hemilucilia segmentaria* (Fabricius, 1805), *Hemilucilia semidiaphana* (Rondani, 1850), *Hemilucilia* sp. and *Lucilia eximia* (Wiedemann, 1819), and *Paralucilia paraensis* (Mello, 1969); and 3 were of Mesembrinellidae: *Eumesembrinella benoisti* (Séguy, 1925), *Eumesembrinella randa* (Walker, 1849), and *Mesembrinella bellardiana* (Aldrich, 1922). Both the rarefaction curve (Fig. 2) and the values of the species richness estimators, ICE, Chao1, and Jack1 (96%) (Table 1), indicated that collecting sites and the complete area assessed were well sampled.

Hemilucilia sp., a species found exclusively in the ZF2 locality, is probably a new species since the male genitalia does not match any of the described species of this genus (*sensu* Dear, 1985 – data not shown). Excluding this species, sampled fauna comprised 12 out of the 18 species (66.6%) currently known for the Brazilian Amazonas state (Table 2). Among these, the most abundant species was *C. idiodea* (66.3%), followed by *E. randa* (8.4%) and *H. semidiaphana* (5%), while *C. macellaria* and *C. megacephala* were the least abundant, represented by less than 25 individuals each (<0.36%) (Fig. 3). With the exception of the exclusive occurrence of *E. benoisti* in Novo Airão and *Hemilucilia* sp. in the ZF2 Reserve (Manaus), as well as the absence of *C. megacephala* in the latter, all species were found in the three localities with somewhat different abundances (Fig. 4). Comparisons between localities showed that Novo Airão is slightly richer than the other two, presenting 12 out of the 13 sampled species, a fact also observed in the rarefaction curve for all localities (Fig. 2). Non-parametrical tests showed no statistically

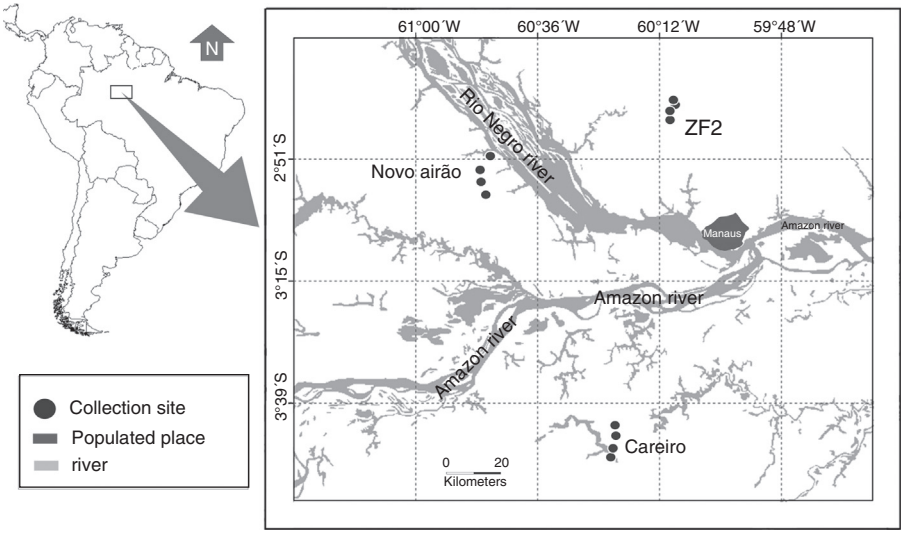

Fig. 1. Collecting sites and sampling points in the Amazonas state, Brazil.