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FIRST RECORD OF SIX CALLIPHORIDAE (DIPTERA) SPECIES IN A SEASONALLY DRY TROPICAL FOREST IN BRAZIL: EVIDENCE FOR THE ESTABLISHMENT OF INVASIVE SPECIES

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Seasonally dry tropical forests occupy approximately 1,048,700 km^2 of which 54.2% are located in South America, where they are exposed to a variety of threats resulting from human activity (Miles et al. 2006). The caatinga ("white forest" in the indigenous language) is a type of dry forest endemic to Brazil that covers an area of 800,000 km^2 and it is characterized by a semi-arid climate, high potential evapotranspiration throughout the year and low and erratic rainfall (Sampaio 1995).

The unfavorable environmental conditions peculiar to the caatinga, such as the periods of severe drought, are expected to be associated with a specialized assemblage of endemic insects adapted to the marked seasonal variations in resource availability. The hostile weather conditions should also act as an obstacle for the establishment of alien species from cooler and more humid regions of the world. However, despite the caatinga's current status as one of the most endangered biomes in Brazil, research on insect diversity, particularly on those that rely on patchily distributed resources, such as necrophagous species, is scarce.

In this paper we describe the first record of necrophagous dipterans of the Family Calliphoridae associated with carrion decomposition in the semi-arid region of Brazil, and briefly discuss the ecological implications of the establishment of non-native species.

The study took place in a conserved caatinga fragment located in the State of Pernambuco (S 07° 59' 09" W 38° 17' 45"), northeastern Brazil, characterized by mean annual rainfall of 430 mm, RH 40% and mean annual temperature of 26 °C, although it can easily reach 40 °C in the dry season (Sampaio, 1995). Vegetation is sparse and characterized by shrub native species, with the predominance of Cactaceae.

The experiment was performed from Mar to May 2010, using 3 male pig (*Sus scrofa* L.; Artiodactyla: Suidae) carcasses (15 kg each) as baits, a procedure that was approved by the local Ethics Committee. After death, the carcasses were placed individually in metal cages (0.9 × 0.6 × 0.5 m) to prevent disturbance by large scavengers. Around the cage, a metal frame (2 m high × 1 m long ×1 m wide) covered with a fine white mesh fabric was placed in order to trap insects that visited the carcass. A 30 cm gap was left between the bottom of the net and the soil, through which insects could enter. The 3 replicates were separated from each other by 1 km. Collection of adult blow flies began 24 h after death and was repeated periodically (at 24 to 48 h intervals) until skeletonization of the carcass (ca. 30 days). Insects were identified in the laboratory, using the taxonomic key of Carvalho & Mello-Patiu (2008).

Six calliphorid species were recorded: *Chloroprocta idioidea* (Robineau-Desvoidy, 1830), *Chrysomya albiceps* (Wiedemann, 1830), *Chrysomya megacephala* (Fabricius, 1805), *Chrysomya putoria* (Wiedemann, 1830), *Cochliomyia macellaria* (Fabricius, 1805) and *Lucilia eximia* (Wiedemann, 1819). Although over 50% of the individuals were collected in the first week, most species were registered, with varying frequencies, in all stages of carcass decomposition. A total of 5,322 adults were collected, distributed as follows: *C. macellaria* (45.54% of all specimens), *C. albiceps* (40.04%), *C. idioidea* (12.61%), *C. putoria* (0.98%), *L. eximia* (0.79%) and *C. megacephala* (0.06%).

Three species are not native to the Neotropical region, i.e., *C. albiceps*, *C. megacephala* and *C. putoria*. Originally from Africa and Asia, they were first detected in the Neotropical region in the late 1970's (Guimaraes et al. 1978). Since then, their geographical distribution has expanded considerably to include several countries in the Americas, including Brazil, Peru, Colombia, Argentina, Costa Rica and the USA (Greenberg 1998; Kosmann et al. 2013). Currently, these species can be found in diverse environments such as agroecosystems, urban areas, the savannah-like Brazilian cerrado, littoral areas, the Brazilian coastal rainforest and the Amazon (Moretti et al. 2008; Biavatti et al. 2010; Vasconcelos & Araujo 2012).

Calliphorid species can act as plant pollinators, and speed up the process of organic matter decomposition; additionally, several species, particularly *C. albiceps*, have been used in the last decades as evidence in forensic entomology cases (Catts & Goff 1992). On the negative side, blowfly species can act as vectors of several pathogens and cause myiasis of man and domestic animals and (Greenberg 1973). Given the poor medical and sanitary conditions of most municipalities

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located in the caatinga's perimeter, the medical significance of our findings deserves further monitoring.

The great abundance of *C. albiceps* leads to the conclusion that the species is well established in the caatinga biome, which can pose threats to populations of native species. Several studies highlight the deleterious effects, which include smaller pupal weight, death from predation and reduced emergence of populations of *C. macellaria* when in competition with *Chrysomya* species (Aguiar-Coelho & Milward-de-Azevedo 1995). Ecological consequences of this establishment are related to the aggressive behavior, high fecundity, dispersal ability, short life cycle and adaptations to different climates (Faria et al. 1999).

In extreme condition such as dry seasons in the caatinga, a recently dead animal consists of an "island" of available nutrients colonized by a wide variety of necrophagous, saprophagous, and predatory arthropods. The codominance of *C. albiceps* demonstrates that this species is a direct competitor with the native *C. macellaria*. Results presented here expand considerably the knowledge on the geographical distribution and environmental plasticity of these exotic, forensically important, species. Also, the notion that *Chrysomya* species are highly synanthropic should be reexamined, given their occurrence in a conserved forest fragment with minimal anthropogenic disturbance. Additionally, the forensic relevance of *Chrysomya* species is reinforced, as there are substantial data on their ecology and life cycles that support their use in the estimation of postmortem interval in homicides cases (Catts & Goff 1992).

This is, to our knowledge, the first record of necrophagous Calliphoridae in a semi-arid environment in Brazil and this information helps in understanding the geographical range and abiotic requirements of these species. Our results suggest that the current knowledge on the dispersal and habitat use of several alien species is far from being elucidated and stress out the need for long-term studies on the conservation of native species in dry forests.

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Summary

As part of a survey on necrophagous Diptera species in a fragment of seasonally dry tropical forest in Brazil, six species of Calliphoridae are reported here for the first time in the *caatinga*, a biome exclusive to Brazil. Three species native to the Neotropical region (*Cochliomyia macellaria*, *Chloroprocta idioidea*, *Lucilia eximia*) and 3 exotic species (*Chrysomya albiceps*, *C. putoria* and *C. megacephala*) are reported to occur simultaneously associated with pig carcasses in the semi-arid region of Brazil. The invasive potential of *Chrysomya* species is likely to produce deleterious effects on native blow fly populations in the near future.

Keywords: *Chrysomya albiceps, Cochliomyia macellaria,* forensic entomology, caatinga, necrophagous insects

Resúmen

Como parte de un estudio sobre las especies de dípteros necrófagos en un fragmento de bosque tropical caducifolio en Brasil, se reportan seis especies de Calliphoridae aquí por primera vez en la *caatinga* un bioma exclusivo de Brasil. Tres especies nativas de la región Neotropical (*Cochliomyia macellaria*, *Chloroprocta idioidea* y L*ucilia eximia*), y tres especies exóticas (*Chrysomya albiceps*, *C. putoria* y *C. megacephala*), ocurren al mismo tiempo asociada a los cadáveres de cerdos en un fragmento de bosque seco. El potencial invasor de las especies de *Chrysomya* puede producir efectos nocivos sobre las poblaciones de moscas necrófagas nativas en un futuro próximo.

Palabras Clave: *Chrysomya albiceps, Cochliomyia macellaria,* entomología forense, caatinga, insectos necrófagos

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