Actions of the Fire Ant Solenopsis saevissima (Smith) (Hymenoptera: Formicidae) on a Big-Eared Opossum Carcass

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Actions of the fire ant *Solenopsis saevissima* (Smith) (Hymenoptera: Formicidae) on a big-eared opossum carcass

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Insects associated with carcasses have been studied due to their significant role in elucidating issues related to the biological diversity present, the nutrients that make up ecosystems, and the environmental processes involved (Pujol-Luz et al. 2008; Oliveira-Costa 2011). Insects in the order Diptera are considered to be the most significant because they are actively involved in the decomposition process (Smith 1986). The second most important order are the Coleoptera, mainly during the final decomposition stages (Mise et al. 2007), and finally, the order Hymenoptera, especially the ants, which play considerable roles in the studies of forensic entomology (Oliveira-Costa 2011).

The family Formicidae are often found in association with vertebrate carcasses, where they obtain additional food by predation of offspring of other necrophagous insects that colonize the corpse early in the decomposition process (Early & Goff 1986). Among those, ants in the genus *Solenopsis* Westwood (fire ants) stand out due to their generalist and opportunistic eating habits (Vinson & Greenberg 1994), their presence in all stages of decomposition, and their ecological role in this process. Due to its relationship with other components of the cadaver fauna, *Solenopsis* was classified by Oliveira-Costa (2011) as the most important ants in forensic entomology studies (Campobasso et al. 2009; Celino 2014).

Although *Solenopsis saevissima* (Smith) (Hymenoptera: Formicidae) is known to be associated with carcasses, studies on the behavior of these ants in the decomposition process, and their predatory and necrophagous action on cadavers are still incipient. Thus, the objective of this work was to record the activity of *S. saevissima* on a big-eared opossum (*Didelphis aurita* Wied-Neuwied) (Mammalia: Marsupialia: Dedelphidae) carcass, with the intent of increasing our knowledge about this ant's behavior and role in decomposition.

The observations occurred beside a public paved highway in the city of Juiz de Fora, Minas Gerais State, southeastern Brazil, which has a warm subtropical climate (Cwa) with a rainy season (Oct to Apr) and a dry season (May to Sep) according to the classification of Köppen (Sá-Júnior et al. 2012). Data were collected from 12 to18 Nov 2017 when the average temperature was 21.8 °C ± 4.12 °C (SD) (range 13–28 °C) and the average relative humidity was 68.5% ± 14.7% RH (SD) (range 37–96% RH), with precipitation during the first d (16.4 mm) (Laboratory of Climatology and Environmental Analysis, Universidade Federal de Juiz de Fora).

The big-eared opossum carcass was found on soil at about 8 AM on 12 Nov 2017, with probable cause of death due to being struck by a vehicle (possibly during the night from 11 to 12 Nov), and was in the initial stage of decomposition (fresh), according to the classification of Scaglia (2014). At the end of that d, signs of bloating already could be observed. In order to record the behavioral data of the fire ants on the carcass, ad libitum observation methods were used.

At the time of the encounter, only fire ants were observed acting directly on the carcass. They were found more intensely in the natural cavities of the body (such as muzzle, eyes, and ears), burying the carcass, and sealing the access to the natural orifices of the animal (Fig. 1A). Fire ants also were observed on the posterior of the animal's body, constructing another mound near the tail (Fig. 1B). Although other necrophages (Diptera) approached, there was no oviposition in or on the carcass.

On 14 Nov, the carcass was moved from the original location, disrupting the soil structure constructed by the ants and allowing colonization by other necrophagous insects (Calliphoridae) (Fig. 1C). In spite of this, the ants continued activities on and in the carcass (though less intensely), along with other insects such as dipterans (Fig. 1C) until the final stages of decomposition.

On 15 Nov carcass rupture occurred which, together with the mass of necrophages acting on the carcass, accelerated decomposition. Even with other necrophages now present, the ants continued foraging. Observation was completed on 18 Nov when the carcass was in the skeletonization phase (Fig. 1D).

Maciel et al. (2015) observed ants of *S. saevissima* burying a cat (Carnivora: Felidae) carcass, mainly in the region of the head. According to the authors, *Solenopsis* burying behavior shows the dominance of this genus by preventing access by other necrophagous insects. Maciel et al. (2016) reported that *S. saevissima* also was present within vertebrate carcasses, but in this case the behavior of burying the body was not observed. This absence of the burying behavior may have occurred because the carcass observed by Maciel et al. (2016) was smaller than that of the opossum recorded here, which may not have required such a strategy from the ants.

The behavior of covering the natural orifices in a carcass may or may not be typically exhibited by fire ants, and also could be related to the size of the carcass. Its effect suggests a strategy to reduce competition for the resource, especially with necrophagous flies, because the structure prevents access by the flies for egg deposition. In addition, we suggest that covering the carcass may modify the environment, possibly making it more suitable for the ants or less suitable for other necrophages.

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Fig. 1. Carcass of big-eared opossum (*Didelphis aurita*) colonized by fire ants *Solenopsis saevissima* (Hymenoptera: Formicidae) and other insects on 12 Nov 2017, Juiz de Fora, Minas Gerais, Brazil. (A) Fire ants initially monopolized the carcass, constructing a dirt mound on the muzzle, thus displaying the burying behavior of the ants. (B) Circled are ants beginning construction of a soil mound near the tail. (C) Diptera depositing eggs on the carcass. After the carcass was moved to the periphery of the roadway, the ants lost their dominance to other necrophagous insects. (D) Skeletonized carcass; ants and other necrophagous insects remained until the end of the decomposition process.

During our observations, the ants became more concentrated in more central parts of the carcass, acting as necrophages in the natural orifices and viscera. In the final phases of decomposition, with the increase of colonization by other insects, the ants adopted a more peripheral position, which can be explained by the ants' function as predators, feeding on fly eggs and larvae, and wandering individuals in contact with the carcass.

The shift to peripheral feeding locations by the fire ants on the carcass in the final stages of decomposition corroborates the observations of Celino (2014), who discussed that ants change their ecological position in the corpse during different stages of decay, acting initially as necrophages, and with the appearance of the first larvae of other insects becoming predators of dipteran larvae, newly emerged adults, and even dead insects in the soil.

In a study by Andrade-Silva et al. (2015) with pig carcasses, 2 *Solenopsis* species (*S. globularia* [Smith] and *S. saevissima*) (both Hymenoptera: Formicidae) were found predating fly larvae and causing injury in the carcass, also demonstrating their important role during the early stages of entomological succession.

The report of the presence of *S. saevissima* in a medium-sized vertebrate carcass during all stages of decomposition, and acting at different ecological levels, shows the behavioral flexibility of the fire ants, and the importance of knowing more about their foraging habits within the context of forensic entomology. This could reduce the chance of possible misinterpretation of the calculation of post-mortem interval due to the changes caused by ants, because the ant behavior of blocking access to other necrophages to the carcass prevents fly larvae from foraging at the beginning of the decomposition process, which ends up delaying that process and generating a lower calculation of IPM than in a scenario where there are no ants present.

Summary

We described the effects of fire ants (*Solenopsis saevissima*) (Hymenoptera: Formicidae) on and in a big-eared opossum (Mammalia: Marsupialia: Dedelphidae) carcass. The observations were made in southeastern Brazil beside of a public highway. We documented the competitive ability of the fire ants, which sought to reduce competition with necrophagous flies by constructing a soil structure over the natural orifices of the carcass. After we removed the structure, the ants changed their physical and ecological behavior on the carcass until the end of decomposition. This ant behavior of blocking access to the carcass delays the decomposition process due to the fact that other necrophagous insects cannot forage there.

Key Words: decomposition, necrophagous, forensic entomology

Sumario

Este estudio describe la presencia y la actuación de las hormigas de fuego (*Solenopsis saevissima*) (Hymenoptera: Formicidae) en un cadáver de zarigüeya orejona (Mammalia: Marsupialia: Dedelphidae). Las observaciones ocurrieron en el sudeste de Brasil en una vía pública del perímetro urbano. Este estudio registró la capacidad

de optimización de las hormigas de fuego, que buscaba reducir la competencia con las moscas necrófagas mediante la construcción de una estructura sobre los orificios naturales de la carcasa. Más tarde, después de la eliminación de esta estructura, las hormigas cambiaron su posición física y ecológica en el cadáver, pero permanecieron activas hasta el final de la descomposición. Este comportamiento de la hormiga de bloquear el acceso a la carcasa, retrasa el proceso de descomposición, debido a que otros necrófagos no pueden alimentarse allí.

Palabras Clave: descomposición, necrófagos, entomología forense

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