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Record of *Ataenius picinus* Harold, 1868 (Coleoptera: Scarabaeidae: Aphodiinae) associated with exposed carcasses in Southern Brazil

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Abstract

Ries ACR, Silva VC, da Silva PG, Blochtein B, Thyssen PJ. 2016. Record of *Ataenius picinus* Harold, 1868 (Coleoptera: Scarabaeidae: Aphodiinae) associated with exposed carcasses in Southern Brazil. Entomotropica 31(6): 48-53.

Ataenius picinus Harold, 1868 is a scarab beetle, which is distributed worldwide. Individuals of this species have been found associated with animal feces, soil samples, leaf litter and decaying fruit, as some cases on carcasses. In this study, we propose the extension of trophic niche of this species based on observations of alternative scavenging resources. Individuals were collected from the carcasses of domestic pigs in southern Brazil. We collected 126 individuals, which represented 68 % of beetles collected during the total decomposition period (14 days). The observed abundance was higher in the decay stage and thus, given this preference, this species may be useful for estimating the maximum postmortem interval, based on the chronology of species arrival at the resource.

Additional key words: Decomposition, forensic entomology, postmortem interval.

Resumo

Ries ACR, Silva VC, da Silva PG, Blochtein B, Thyssen PJ. 2016. Record of Ataenius picinus Harold, 1868 (Coleoptera: Scarabaeidae: Aphodiinae) associated with exposed carcasses in Southern Brazil. Entomotropica 31(6): 48-53.

Ataenius picinus Harold, 1868 é um escarabeídeo com distribuição em todo mundo. Os indivíduos desta espécie têm sido encontrados associados com fezes de animais, amostras de solo, serapilheira e frutas em decomposição, e alguns casos em carcaças. Neste estudo, propomos a extensão do nicho trófico da espécie com base em observações de recursos de alimentação alternativos. Os indivíduos foram coletados a partir das carcaças de suínos domésticos no sul do Brasil. Foram coletados 126 indivíduos, o que representou 68 % dos besouros coletados durante o período de decomposição total (14 dias). A abundância observada foi maior na fase de murchamento, e dada essa preferência, a espécie pode ser útil para estimar intervalo post-mortem máximo, baseado na cronologia de chegada as espécies ao recurso.

Palavras chave adicionais: Decomposição, entomologia forense, intervalo *post-mortem*.

Introduction

Coleoptera comprises the animal group with the highest taxonomic richness with approximately 360,000 species described in 221 families (Bouchard et al. 2009, 2011). About 28,000 species in 105 families of Coleoptera occur in Brazil (Rafael et al. 2012). Coleoptera is one of the most important insect order in Forensic Entomology because several species of beetles have necrophagous feeding habits (Souza 2014).

According to their slower mobility compared to flies, beetles tend to colonize the carcass at later stages, possibly due to an evolutionary strategy in order to avoid competition with flies for resources (Crowson 1981). In addition, beetles feed on resources not accessible to other groups; with their biting mouthparts and specialized digestive tract, they are able to processing more rigid and dried parts of corpses in advanced stages of decomposition. Because of this, beetles are the main tool for establishing the maximum postmortem interval (Santos 2014), and other aspects of death, such as displacement of bodies (Smith 1986).

Aphodiinae is a representative of the family Scarabaeidae with more than 3,100 species of small size, which either feed on dung or have other saprophagous feeding habits (Stebnicka 2001, Skelley and Smith 2007). The knowledge on fauna of Aphodiinae in Brazil is poor. However, these beetles have important roles in various environmental contexts because they are scavengers (Marinoni et al. 2001), a behavior that facilitates the decomposition of animal and/or plant organic matter (Nichols et al. 2008). Some Aphodiinae species are regarded as pests because their larvae can damage seedlings and the adults may also attack plants in some cases (Watt 1984, Marinoni et al. 2001, Stebnicka 2001).

Ataenius picinus Harold, 1868 is an Aphodiinae species with the widest distribution throughout the worldI. Itt has many synonyms, and is currently placed in the group *Ataenius strigicauda* Bates, 1887 (Stebnicka 2004). The distribution of this species includes South America, Central America, southern North America, and Oceania, which is possibly attributable to human transportation in the ballast of ships or with livestock, and to its high capacity for tolerating environmental adversity (Smith and Skelley 2007). Specimens of *A. picinus* can be collected in the light (Watt 1984), in pitfall traps baited with animal feces (Cartwright 1964), as well as from soil and leaf litter and decaying fruit (Watt 1984). It has also been associated with carcasses (Mise et al. 2007). Although it is found on various substrates, Marinoni et al. (2001) listed this species as a dung feeder. Many Scarabaeidae species are found and considered to be important in forensic studies (Mise et al. 2007, Santos et al. 2014), but little is known about *A. picinus* and its relevance in this context. In the present study, given the ecological role of *A. picinus*, we aimed to evaluate the behavioral habits of this species to possibly expand its preferred niches, taking into account the optional scavenging observed here.

Materials and Methods

The experiment was conducted during December 2011 at FEPAGRO Research Station in Viamão, metropolitan region of Porto Alegre, Rio Grande do Sul State, Brazil, which is located in an area that contains remnants of subtropical forest and fields (30º 2' 10.47" S, 51º 1' 19.05" W). Three male domestic pig carcasses (*Sus scrofa* Linnaeus, 1758) were exposed, each of which weighed approximately 16 kg. The animals were killed by shooting and placed immediately in metal mesh boxes (1.5 cm^2) with dimensions of 100 cm^3 x 70 cm^3 x 60 cm^3 to avoid the intervention of vertebrates and to allow access of insects . The average temperatures and relative humidity data were obtained from the nearest weather station (INMET 2014). The classification of the stages of decomposition

followed that proposed by Monteiro-Filho and Penereiro (1987).

We used six pitfall traps to sample the fauna of Coleoptera. Traps were placed 10 cm from the boxes and were equidistant from each other. We performed active daily collections at noon until only bones remained and beetles were no longer present. The collecting was performed on pig surface, *i.e.*, without handling the carcass. The insects recovered were identified using taxonomic keys (Smith and Skelley 2007), and they were deposited at the Museum of Science and Technology of the Pontifical Catholic University of Rio Grande do Sul.

Treatment of the animals followed the recommendations set forth by the National Council for Control of Animal Experimentation (CONCEA) and legislation (Arouca Law No. 11.794, of 08/10/2008), in addition to Resolution 714 of the Federal Council of Veterinary Medicine. The Ethics Committee for Animal Use (CEUA) at the Pontifical Catholic University of Rio Grande do Sul approved the experiment (registration 152 dated of 28/11/2011).

To investigate possible correlations between the number of *A. picinus* specimens sampled at different stages of decomposition and the distribution of the number of individuals collected relative to the temperature and humidity, we determined the Pearson's correlations coefficients and performed Spearman's rank correlation tests, respectively. The normality of the data was verified using the Shapiro-Wilk test. Data were visualized using stats package from R program (R Core Team 2014).

Results and Discussion

The decomposition of the carcasses lasted fourteen days, and four stages of decomposition were observed: Fresh, Bloated, Decay and Dry Stage. The duration of each decomposition stage was determined according to the physical changes observed in the exposed pig carcasses. Fresh stage lasted one day, the bloated stage lasted from the second to third day. Decay stage was the longest lasting seven days. After the carcasses reached the dry stage the experiment was fended four days later, because no insect activity could be observed anymore, and only bones and hair were left (Figure 1).

In total, 126 adult specimens of *A. picinus* were recovered, which represented 68 % of the beetles collected. Indeed, it was the only species recorded in Aphodiinae. It was present in three of the four stages of decomposition, but its abundance was higher during the decay stage, in all three carcasses (Figure 1). In general, both larva and adult stages of Aphodiinae species are associated with vertebrate feces and plant organic material (Watt 1984, Marinoni et al. 2001, Stebnicka 2001). Hence, the high abundance of *A. picinus* found in pig carcasses in southern Brazil is surprising. Mise et al. (2007) found only four individuals of this species associated with carcasses of *S. scrofa* in Curitiba, Paraná (Southern Brazil). During the decay stage changes in the shape of the carcass occur, with the skin splitting in several areas and consequent release of gases (Moura et al. 1997). Due to the rupture of the skin, the intestine and feces of the carcass are exposed. As the dung feeding habit is predominant among species of *Ataenius* Harold, 1867 and its species follow odor plumes, a higher attraction of coprophagous beetles at the decay stage can be expected.

There was a positive correlation between the number of *A. picinus* individuals sampled per stage and the number of days duration for each of these stages ($R = 0.99$; $p < 0.05$), that is, the number of days of duration of the decomposition stage had an influence on the abundance of individuals. Kocárek (2003) and Bana and Beyarslan (2012) stated that the beetles are attracted to specific stages, *i.e.*, they

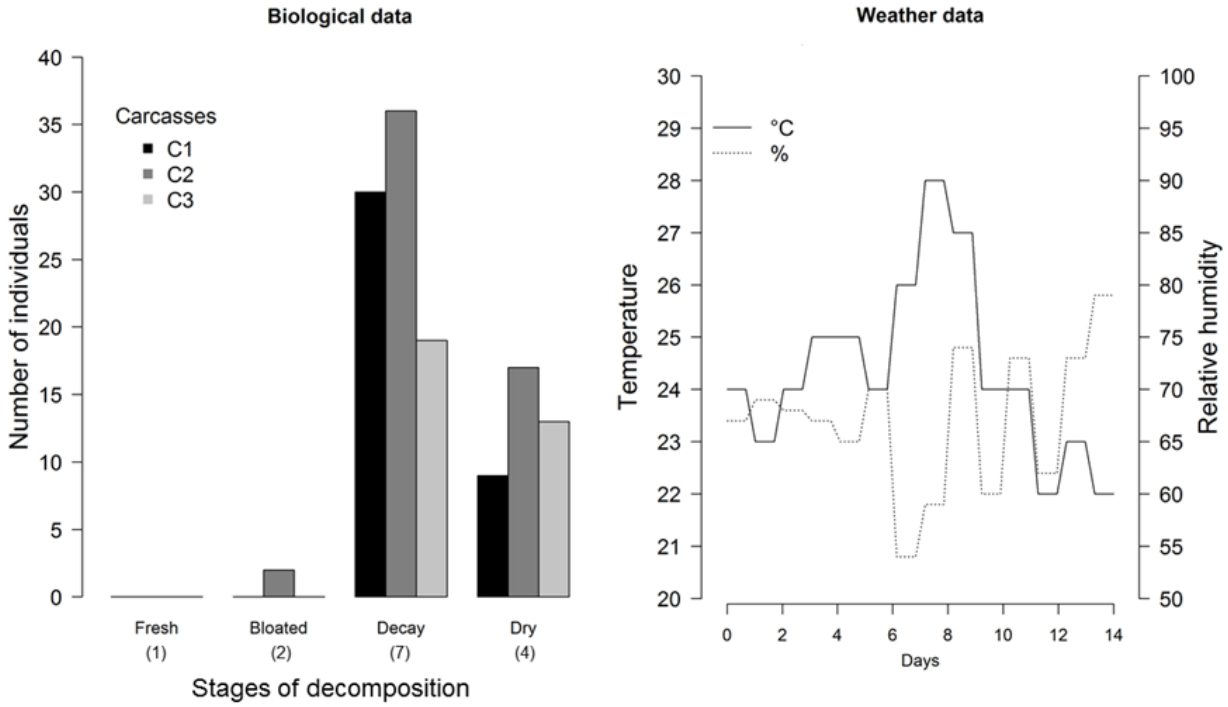

Figure 1. Number of individuals of *Ataenius picinus* Harold, 1868 by stage of decomposition and carcass, which were collected from exposed pig carcasses in southern Brazil, and mean temperature and relative humidity during the period of collect. The numbers in parentheses show the length of each stage in days.

seek resources or substrates that provide the ideal conditions for laying eggs or feeding. Thus, it is possible that the features of the decay stage include chemical and physical conditions that are also favorable for *A. picinus*, at least those usually preferred in nature. Mise et al. (2007) also reported the presence of this species at the same stage of decomposition, but they referred to this as the butyric fermentation stage because they used another classification.

There were no correlations between the numbers of *A. picinus* individuals and the mean temperature ($r = -0.43$; $p < 0.05$) or the relative humidity ($r = 0.04$; $p > 0.05$) during the decomposition of the carcasses. Higher temperatures directly affect the development of insects (Wigglesworth 1984), and thus the rate of population growth. However, the short sampling period of our study did not show high variation in climatic conditions as to affect the distribution of *A. picinus* (Figure 1).

In general, the Aphodiinae fauna associated with carcass decomposition remains poorly understood due to the taxonomic limitations, which only allowidentification to subfamily or genus level. However, Marchiori et al. (2000) sampled two unidentified species of *Ataenius*, which were among the most abundant insects associated with pig carcasses in Goiás, Brazil. Rosa et al. (2011) also recorded Aphodiinae, including *Ataenius* sp., *Ataenius aequalis* Harold, 1880 and *Labarrus pseudolividus* (Balthasar, 1941) in the carcasses of *S. scrofa* in Minas Gerais, Brazil. Silva and Santos (2012) sampled unidentified *Ataenius* individuals associated with *Oryctolagus cuniculus* (Linnaeus, 1758) in Paraná, while Panigalli and Soligo (2013) recovered unidentified Aphodiinae specimens

from the carcasses of *S. scrofa* in Santa Catarina, southern Brazil. Santos et al. (2014) collected unidentified *Ataenius* individuals in Caatinga (Paraíba) associated with exposed pig carcasses.

The data obtained in this study and the results of other investigations conducted in Brazil show that Aphodiinae species, specifically *Ataenius*, are potential scavengers and this is not simply an accidental habit. Given the preference of *A. picinus* for the later stages of decomposition, this species may be useful in questions applicable to forensic entomology.

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