

Scientific Note

A Scarab Feeding on Another Scarab: First Observation of Necrophagy by *Canthon histrio* (Le Peletier de Saint-Fargeau & Audinet-Serville, 1828) (Coleoptera: Scarabaeidae: Scarabaeinae) on a Dead Passalidae

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Abstract. Besides the widely known behavior of *Atta* Fabricius, 1804 (Hymenoptera: Formicidae) predation by *Canthon* spp., knowledge of the dietary range of *Canthon* species is scarce. This note documents the first observation of necrophagy by the dung beetle *Canthon histrio* (Le Peletier de Saint-Fargeau & Audinet-Serville, 1828) (Coleoptera: Scarabaeidae: Scarabaeinae) on a recently dead Passalidae (Coleoptera) beetle. The dung beetle exhibited typical nesting behavior by digging into the substrate beneath the Passalidae, although it faced challenges due to the compacted soil. This observation highlights the diverse dietary habits of *Canthon* species, suggesting that necrophagy may be more widespread than previously documented.

Keywords: Copro-necrophagous beetles, Deltochilini, Dung beetle behavior, food resources, bess beetles.

Non-coprophagous behavior in Scarabaeinae (Coleoptera, Scarabaeidae) is reported from a variety of genera, including *Deltochilum* (*Aganhyboma*) Kolbe, 1893, *Deltochilum* (*Deltohyboma*) Lane, 1946, *Zonocopriss* Arrow, 1932, *Coprophanaeus* d'Olsoufieff, 1924, and *Canthon* Hoffmannsegg, 1817 (Silveira et al. 2006; Vaz-de-Mello 2007; Silva et al. 2012; Santiago et al. 2022). These beetles can feed on a variety of resources such as living prey (Silva et al. 2012; Sánchez-Hernández & del Campo 2023), fruits and vegetables detritus (Halffter & Halffter 2009; Chaboteaux et al. 2023), fungi (Philips 2016; Anduaga 2000), and dead organisms (Villalobos et al. 1998). Among those that prey on living organisms are *Deltochilum* (*Aganhyboma*) *viridescens* Martínez, 1948 and *Deltochilum* (*Aganhyboma*) *trisinatum* Harold, 1881, which feed on diplopods, as well as *Canthon* (*Canthon*) *lucreciae* Halffter & Halffter, 2009 (Pereira & Martinez 1956; Silva et al. 2012; Sánchez-Hernández & del Campo 2023). Another example is *Canthon* (*Canthon*) *virens* (Mannerheim, 1829), which may represent the most extensively studied predatory behavior on *Atta laevigata* (Smith, 1858) (Hymenoptera: Formicidae), cited from 1937 to 2022 (Borgmeier 1937; Navajas 1950; Hertel & Colli 1998; Silveira et al. 2006; Forti et al. 2012; Aquino et al. 2018; Oliveira et al. 2022). Additionally, *Canthon* (*Francmonrosia*) *dives* Harold, 1868 has been reported by Borgmeier (1937) as a predator of gynes of *A. laevigata*, which may represent the first report of non-coprophagous behavior in *Canthon*, as far as we know. *C. dives* is a coprophagous species and this seemingly wrong report is probably due to similar size, color and co-occurrence with *C. virens* which is the only confirmed predator over *Atta* Fabricius, 1804 to now (F.Z. Vaz-de-Mello, personal observation). Recently, a report documented the predation of *Canthon chalybaeus* Blanchard, 1845 on the gastropod *Bulimus apodemetes* (A. d'Orbigny, 1835) (Martín et al. 2021), highlighting the diverse dietary habits of *Canthon* species.

Other behaviors within Scarabaeinae include myrmecophily (Vaz-de-Mello et al. 1998; Gillett & Toussaint 2020), termitophily (Wasmann 1918; Philips 2016); but also commensalism between dung beetles and terrestrial gastropods as it is the case with *Zonocopriss* spp. (Vaz-de-Mello 2007). Although knowledge of the diverse food resources utilized by scarabs has been increasingly elucidated, significant gaps remain

regarding various groups and species. Therefore, studies and reports describing the behavior of these species serve as a complementary approach to enhancing our understanding of scarab species dietary specialization. This study aims to document for the first time the behavior of a scarab (Scarabaeoidea, Scarabaeidae, Scarabaeinae, *Canthon histrio* (Le Peletier de Saint-Fargeau & Audinet-Serville, 1828) (Fig. 1) feeding on a dead scarab (Scarabaeoidea, Passalidae, *Passalus* sp.).

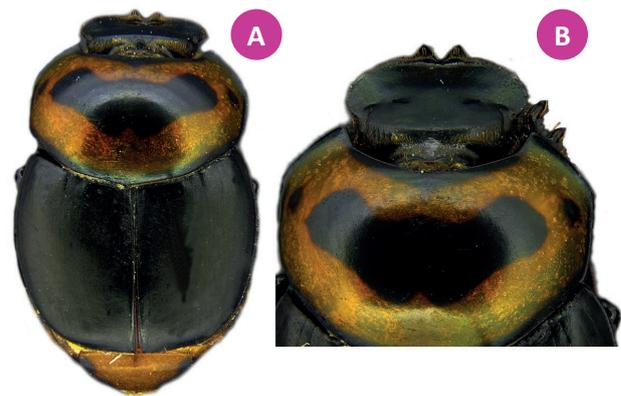


Figure 1. *Canthon histrio* (Le Peletier de Saint-Fargeau & Audinet-Serville, 1828) (Coleoptera, Scarabaeidae) A - dorsal and B - pronotum-head habitus. B. clypeal teeth. Scale bars 1mm.

The observation regarding the necrophagous behavior of *C. histrio* was conducted in the CEPEC's experimental fields (14°45'24" S, 39°14'3" W, elevation 50 m), Ilhéus, Bahia, Brazil. The sampled area is surrounded by cocoa agroforestry parcels managed under various arrangements and local practices. The soil is a typical Eutrophic Haplic Nitosol (Santana et al. 2016). The region is part of a hotspot of biodiversity, the Brazilian Atlantic Forest (Myers et al. 2000) being with many endemic species of insects (Delabie et al. 2020; Dos-Reis et al. 2025).

On November 5th 2024, at 13:42 h on a trail (Fig. 2D), we observed a specimen of *C. histrio* actively burying a freshly dead Passalidae on the ground (Fig. 2A-C). The observation lasted about 170 min (from 13:42 h to 16:32 h). The scarab predator was not sampled but the Passalidae beetle was collected and mounted for identification. During the observation, the dung beetle was digging into the substrate underneath the Passalidae and threw the soil tentatively to bury it (Fig. 2). During several attempts, the scarab tried to dig; however, its efforts were unsuccessful because the local soil was highly compacted as the area was a trail frequently used by pickup trucks and heavy vehicles such as tractors to access the experimental plots (Fig. 2D). Finally, it only dug a shallow hole that had its height in depth and twice its length in width. The species is commonly found in local cocoa agroforestry systems within CEPEC (C. Dos-Reis, personal observation). Specimens of the beetle collected in the same area have been deposited at the Gregorio Bondar Entomological Collection of CEPEC/CEPLAC, Ilhéus, Bahia.



Figure 2. A dung beetle, *Canthon histrio* (Le Peletier de Saint-Fargeau & Audinet-Serville, 1828) (Coleoptera, Scarabaeidae), burrowing a dead Passalidae. *Canthon histrio* beetle trying to shovel the Passalidae A-C; D, CEPEC's experimental trail.

Generally, dung beetle species exhibit the behavior of building galleries beneath food resources or rolling them into balls to bury in these galleries at a distance from the original location (Halffter & Edmonds 1982; Hanski & Cambefort 1991; Huerta et al. 2023). However, species may present a variety of nesting behaviors, ranging from simple oviposition in dung to complex brood care strategies involving food relocation, burrow construction, and parental investment, reflecting adaptations to resource availability and competition (Halffter & Edmonds 1982). The nesting behavior of *C. histrio* is classified as a variation of nesting pattern IV in dung beetles, where the female adds an external layer of soil, which enhances its potential protective function (Cortez et al. 2021).

Although there may be some degree of cooperation between male and female in the construction of the brood balls in dung beetle rollers (Halffter & Edmonds 1982; Cortez et al. 2021; Huerta et al. 2023), we did not observe such behavior. This may be due to the presence of a single dung beetle specimen during a limited event, which interrupted the rest of the cycle, likely because of soil hardness (Cortez et al. 2021).

Although literature primarily presents the behavior of dung beetles regarding a variety of invertebrates, reports of predation on other coleopterans, including Scarabaeoidea, are very scarce. Despite the fact that specimens of *C. virens* have been reported feeding on *Dichotomius* Hope, 1838, and *Isocopris* Pereira & Martinez, 1960 (Scarabaeidae, Scarabaeinae); no further information was provided (Vaz-de-Mello et al. 1998). The same applies to *Canthon cyanellus* LeConte, 1859, with both males and females feeding on carcasses of *Phanaeus* MacLeay, 1819 and *Copris* Geoffroy, 1762, but yet again, no details were provided (Villalobos et al. 1998). In Calakmul, Campeche, México, *C. cyanellus* was observed feeding on *Enema endymion* Chevrolat, 1843 (F. Escobar-Hernández, personal communication).

We did not observe whether the Passalidae was alive but injured or already dead at the time *C. histrio* arrived, but its death was certainly very close. Imagos of *C. lucreciae* beetles have been observed preying on injured millipedes in Mexico (Sánchez-Hernández & del Campo 2023). Nonetheless, *C. histrio* was able to damage and cut parts of the insect's tissue, specifically in the left lateral region between the pronotum and mesonotum, and on the abdominal segments beneath the left elytra (Fig. 3A-B). The ability of a *Canthon* species to cut tissues

on prey or any food resource may be attributed to the clypeal teeth (Fig. 1B), which serve as a type of knife (Halffter & Matthews 1966; Villalobos et al. 1998).

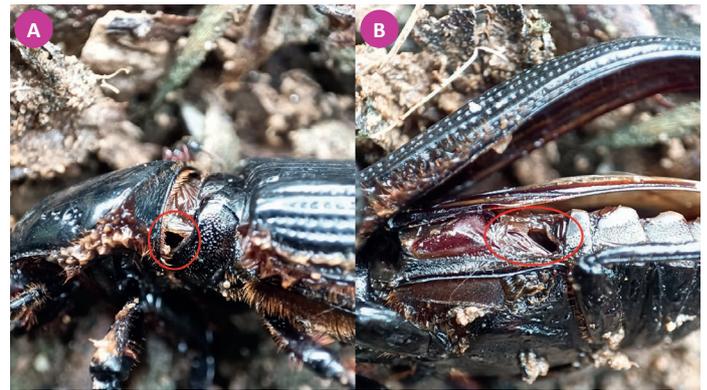


Figure 3. Damage caused by *Canthon histrio* (Le Peletier de Saint-Fargeau & Audinet-Serville, 1828) (Coleoptera, Scarabaeidae) on A - the pronotum-mesonotum portion and B - the abdominal segment beneath the left elytra.

Although the genus *Canthon* consists primarily of coprophagous species (Halffter & Matthews 1966) and we confirm this behavior to *C. histrio* on the CEPEC's experimental areas, dung beetles may exhibit non-coprophagous behavior without necessarily having changes in their mouthpart anatomy. The reason is that they can ingest only the thick paste containing juices and microorganisms (Halffter & Halffter 2009). Coprophagous dung beetles use to exhibit plasticity and may feed on various types of decaying resources, including dead and living invertebrates, fruit, vegetable detritus, and fungi, depending on the local scarcity of their preferred food resources (Halffter & Matthews 1966; Halffter & Halffter 2009).

The 'unusual' feeding and nesting behavior of dung beetles continues to emerge with new information, highlighting how limited our knowledge is regarding the extent of their dietary and nesting habits at the species level (Huerta et al. 2023).

Canthon histrio is a species with a generalist habit regarding trophic resource use by adults, having been recorded in different types of environments, ranging from native forest fragments to open areas such as pastures and forest plantations (Correa et al. 2023; 2024), including cocoa agroforest under different conditions (C. Dos-Reis, personal observation). In cocoa agroforests, the species is most abundant in traps baited with human faeces (C. Dos-Reis, personal observation). Although it exhibits habitat plasticity, recent studies have shown a particularly high abundance of this species in more simplified environments, such as homogeneous forest plantations, including teak and peach palm crops (Correa et al. 2024). In the Amazon region, *C. histrio* or a closely related species was collected in high numbers in traps baited with different types of bovine carrion (meat and liver), which reinforces its tendency towards necrophagous behavior (Correa et al. 2023). This dominance in open areas may be associated with its ability to efficiently exploit animal-based resources, such as decomposing carcasses (including insects), and with the lower structural complexity of these habitats, which favors opportunistic species and those tolerant of environmental disturbances (Halffter & Matthews 1966; Nichols et al. 2007; Giménez-Gómez et al. 2020; Reis et al. 2023). Thus, although *C. histrio* also occurs in forested environments, its higher abundance in anthropogenic areas could suggest a shift in resource use patterns, with an intensification of adult necrophagy driven by the more favorable ecological conditions found in simplified habitats.

To the best of our knowledge, the present report is the first documented instance of scavenging by a scarab (Scarabaeidae, *C. histrio*) on another scarab (Passalidae, *Passalus* sp.). In addition to the nesting behavior of this species documented by Cortez et al. (2021), we shed light on its dietary habits, suggesting that non-coprophagous feeding or predation behavior on *Canthon* may be more widespread and common under certain circumstances.

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Authors' Contributions

C.D.-R.: Conceptualization; material preparation, data collection, and visualization; writing - original draft; writing - review and editing. F.Z.V.-de-M.: Writing - original draft; writing - review and editing. J.H.C.D.: Conceptualization; writing - original draft; writing - review and editing.

Conflict of Interest Statement

The authors declare that they have no conflicts of interest or competing interests.

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