PSM Journals

PSM
Biological Research

Research Article 2026 | Volume 11 | Issue 1 | 13-19

Open Access

Article Information

Received: December 5, 2025

Accepted: January 10, 2026

Published: January 20, 2026

Authors' Contribution

AAM designed the study, developed the methodology, confirmed morphological identification and taxonomic analysis, and reviewed and edited the manuscript. WAR collected the specimens, conducted fieldwork, performed primary morphological identification and detailed species characterization, and wrote the draft manuscript. All authors have approved the final version of the manuscript for publication.

How to cite

Al-Azab, A.M., Al Raeeini, W.A., 2026. First Record of *Creophilus maxillosus* (Linnaeus, 1758) (Coleoptera; Staphylinidae) for Yemen: Hairy Rove Beetle of Forensic Entomology. PSM Biol. Res., 11(1): 13-19.

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First Record of *Creophilus maxillosus* (Linnaeus, 1758) (Coleoptera; Staphylinidae) for Yemen: Hairy Rove Beetle of Forensic Entomology

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Abstract:
This is the first study of Coleoptera succession on a decomposing rabbit carcass, *Oryctolagus cuniculus* L., in a shaded area of the laboratory at Thamar University during the winter season 2024 in Dhamar city, Yemen. In the present study, a female specimen of *Creophilus maxillosus* Linnaeus (Coleoptera, Staphylinidae) was collected from a rabbit carcass as a new record from Yemen. In addition, this record may provide a basis for further faunal surveys and encourage deeper research on the necrophagous insect fauna of Yemen. Thus, the present study emphasizes that a continuous survey of carrion-associated beetles is necessary to improve forensic entomology in the studied region.

Keywords: First record, Forensic entomology, Coleoptera, Staphylinidae, *Creophilus maxillosus*, Yemen.

INTRODUCTION

Shortly after an organism's death (including humans), its corpse becomes a limited and irregular food resource for various species (de Melo Silva *et al.,* 2024; Mendoza, 2025). In temperate natural biotopes, insects are the most specialized species in utilizing a "cadaver ecosystem. Animal carcasses have been used as a model for forensic entomology research in many parts of the world, where rabbits were first used for these purposes, in the work of Abouzied (2014). The presence of insects on carcasses can be used to estimate the postmortem interval relevant to biogeographical regions (Iwasa and Okura, 2023; Al-Shorman and Alakkam, 2024). Carrion insects, mainly Dipterans and Coleopterans, are attracted to the corpse in a relatively predictable sequence known as entomofaunal succession or insect succession (Al-Qahtni et al., 2021). Forensic entomology involves the study of insects in both medical and legal contexts (Gaedke *et al.,* 2024). This involves comparing the biological composition observed on the corpse with that of insects collected under controlled settings from an animal model (Mashaly *et al.,* 2018). The type and composition of taxa attracted to a carcass usually change as decomposition progresses (Mashaly *et al.,* 2020), and the succession pattern is unique to the local conditions where the carcass was found (Shaalan *et al.,* 2017). Many reports have concentrated on the colonization patterns of Diptera, with few studies examining Coleoptera succession (Al-Mekhlafi, 2020). Coleoptera is a vast order comprising nearly one-third of all known insects (Eremeev, 2021). These beetles are especially significant in the later stages of decomposition because they feed on skin and hair (Fakoorziba *et al.,* 2017). Carcasses provide animals with survival, shelter, and food sources. According to study by Davis and Deschodt (2018), the complex ecological community of beetles found in carrion can offer valuable evidence for medicolegal investigations. Beetle communities vary by location, but the most common families include Cleridae (checker beetles), Staphylinidae (rove beetles), Silphidae (carrion beetles), Histeridae (clown or hister beetles), Dermestidae (larder, skin, or hide beetles), Geotrupidae, and Nitidulidae (sap beetles) (Mendoza, 2025). The Staphylinidae family can be found in nearly all wet environments worldwide; however, they cannot survive in open waters because they are not truly aquatic. *Creophilus maxillosus* (Linnaeus) is easily recognizable by its yellowish-grey colour and hair-like setae covering its elytra and abdomen. These scavengers thrive on carrion and feed on fly larvae, particularly carrion maggots. Hairy rove beetles have a global distribution and are often found at crime scenes, making them significant for forensic investigations. This species can be used in forensic entomology to determine the time of colonization or the postmortem interval (PMI), both of which are useful in crime scene investigations. A previous study found that the presence of *C. maxillosus* at crime scenes was a reliable indicator of body relocation (Matuszewski *et al.,* 2008). In Yemen, there is a limited understanding of the forensic importance of rove beetles. However, a study of adult Coleoptera was conducted on an exposed cadaver in Dhamar City, and the results revealed the presence of one species from this family.

MATERIALS AND METHODS

Study site

This study was carried out in Dhamar City, which lies between latitudes 14°-15°N and longitudes of 43.30°-44.5°E., located in the central area of the western highland region of Yemen 1600-3200 meters. Dhamar City is approximately 100-kilometer south of Sana'a, the Capital city of Yemen (Figure 1).

Specimen collection and identification

On October 19, 2024, a rabbit carcass (*Oryctolagus cuniculus* L.) killed with chloroform (1.5 kg) was used to simulate human models. Rabbit treatment was approved by the Committee of Biological Sciences at Sana'a University (Ethics Code: BAHSS 103).

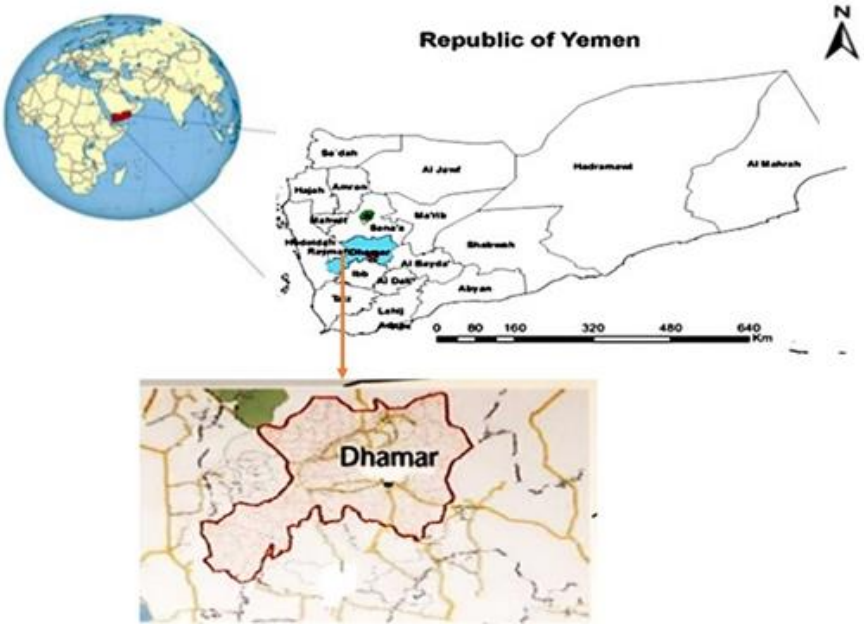

Fig. 1. Map of the study site in Dhamar City, Yemen.

The carcass was placed in a controlled indoor environment in a metal cage with a mesh diameter of 2 cm and kept in a shaded area in the laboratory at Thamar University, Faculty of Agriculture, Dhamar City, to attract necrophagous insects. An adult beetle was captured using forceps, immediately placed in test tubes, and killed with 96% ethanol for further identification. Specimen photographs were taken using a Dino light microscope and a Samsung Galaxy S9. The identification specimens were identified at the species level based on morphological characteristics using standard taxonomic keys (Brunke *et al.,* 2011; Augul *et al.,* 2015; Johsnton *et al.,* 2017). The diagnostic features of *C. maxillosus* concerning body size, colouration, and setae patterns were studied under a stereomicroscope. Voucher specimens were deposited at Sana'a University, Yemen.

Environmental parameters

The recorded temperature and humidity were measured using a Max-Min Thermo Hygrometer [TA318, credits Imagine Instruments LLC]. The mean temperature was 15 °C, and the relative humidity was 52% during the winter season at the laboratory site.

RESULTS AND DISCUSSION

Rove beetles

In this study, one female *Creophilus maxillosus* (Linnaeus1758,), a species of the subfamily Staphylininae (Coleoptera; Staphylinidae), was identified and registered as a new record of Yemen and aligned with findings from previous studies in various regions, including Iran (Samin *et al.,* 2011), Peru (Asenjo, 2007), Turkey (Özdemir and Sert, 2009), Iraq (Augul *et al.,* 2015), Central Europe (Matuszewski, 2012), North America (Johsnton *et al.,* 2017), and North Asia (Eremeev, 2021). The specimen was found on a shaded rabbit carcass (*Oryctolagus cuniculus* L.), which was observed to decompose through five stages after death: fresh, bloated, active decay, advanced decay, and dry. The fresh stage lasted approximately 2 days, the bloated stage lasted 5 days, the active decay stage lasted 10 days, the advanced decay stage lasted 16 days, and the dry stage lasted 30 days during the winter season. However, these durations may vary depending on the habitat and climate, as observed in Riyadh (Mashaly *et al.,* 2020). The occurrence of this species on day 10 corresponds to the active stage of decomposition, and Coleoptera are

generally known to appear in the late decay stage, according to Özdemir and Sert (2009) and Al-Mekhlafi (2020). This finding represents a new record for Yemeni fauna. The significance of *C. maxillosus* in Yemen has major forensic implications for entomology. As this beetle is a predator, it has the potential to affect the rate of succession of necrophagous insects. This means that the estimates of PMI can also be affected.

Morphological Identification of *Creophilus maxillosus* (Hairy Rove Beetle)

The morphological studies on the collected specimen confirmed their identification as *Creophilus maxillosus* (Linnaeus, 1758) based on the diagnostic characters described for the family Staphylinidae. The adult was about 13mm in body length and elongated, with a general dorsoventrally flattened body. It is quite distinctive in appearance, and as its name suggests, may be distinguished from all other species by the yellowish-gray setae on the second and third (and sometimes fourth) abdominal segments and on the elytra, where they form broad bands around the abdomen (Figure 2).

General Appearance

- Medium- large rove beetle (adult 13mm).
- Body elongated, flattened, and very hairy (dense golden or silver setae).
- Colour: generally black with metallic reflections on elytra and abdomen (Figure 2).

- **Head**

The head is characteristic with large eyes and powerful pairs of mandibles with thickly beaded antennae comprising eleven antennomers (Figure 3).

- Large, broad, and shiny black.
- Mandibles are robust and strongly curved.
- Antennae short and clubbed, segments thickened toward the tip.
- Dense golden hairs around the mouthparts (maxillary beard) (Figure 3).

Fig. 2. Adult *Creophilus maxillosus*. Elongated, flattened, and densely hairy bodies. Metallic black in colour.

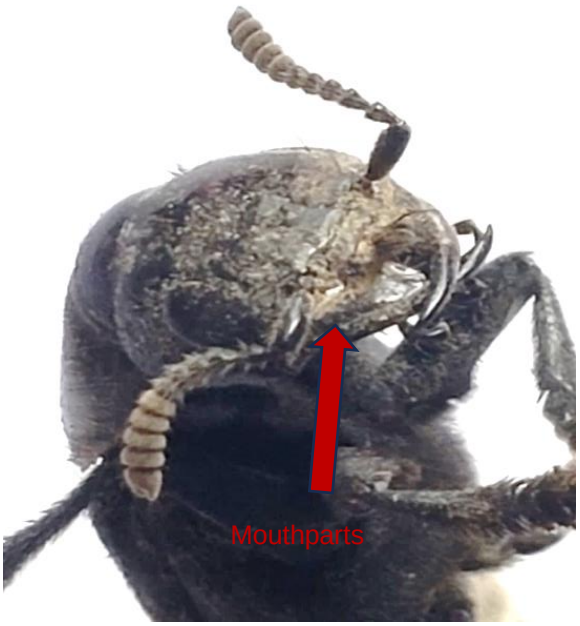

Fig. 3. Head of *C. maxillosus* illustrating robust curved mandibles, short clubbed antennae, and golden setae surrounding the mouthparts.

- **Pronotum**

The pronotum was transverse, wider than long, and densely pubescent (Figure 4).

- Pronotum shiny black, smooth, sometimes without punctures.
- Margins slightly rounded.
- Often contrasts with the densely hairy abdomen (Figure 4).

Fig. 4. Pronotum of *C. maxillosus,* with its glossy, black, and slightly rounded margins.

Elytra

The Elytra were distinctly short, covering only the anterior portion of the abdomen (Figure 5).

- Elytra short (typical for Staphylinidae), not covering the abdomen.
- Usually dark with a metallic sheen.
- Covered with short, stiff setae (Figure 5).

- **Abdomen**

Abdomen is segmented, flexible, and densely setose (Figure 6).

- Very distinctive:
- First visible abdominal segments are covered with dense golden or silver hairs.
- Later segments are often dark and less hairy.
- The last visible sternite; in females, it is apically emarginate (Figure 6).

Fig. 5. Short elytra in *C. maxillosus* with metallic colouring and exposed abdomen.

- **Legs**

The legs are entirely black, robust, with well-developed tarsi (Figure 7).

- Legs long and adapted for running.
- Femora thick and dark.
- Tibia with several strong spines (Figure 7).

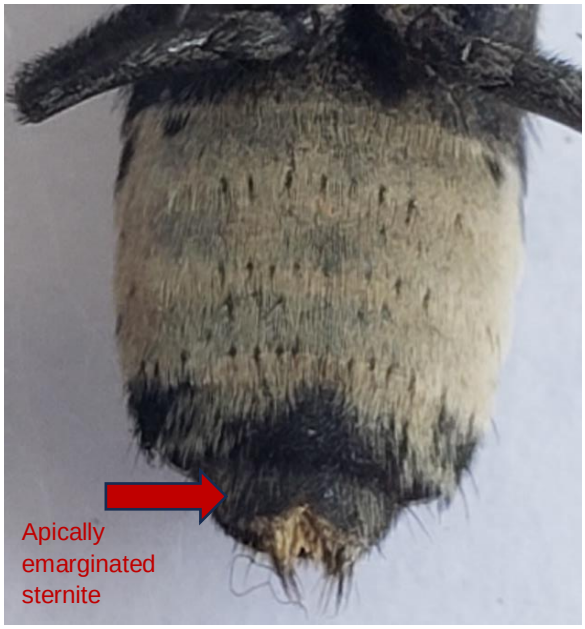

Fig. 6. Abdomen of *C. maxillosus* showing dense setae over the anterior segments, and the apically emarginated terminal sternite in the female.

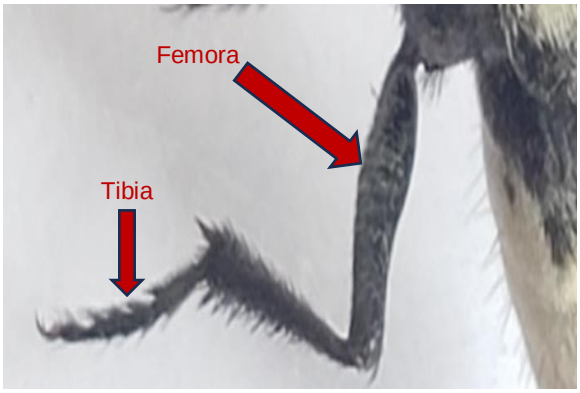

Fig. 7. Legs of *C. maxillosus*, long and adapted for running, with thick femora and spined tibiae.

CONCLUSION

This paper describes, for the first time in the literature, the presence of *Creophilus maxillosus* (Linnaeus, 1758) in Yemen found on a rabbit corpse. This new record not only provides information on the distribution of this insect but also raises its importance in forensic entomology. Knowledge of the distribution and involvement of *Creophilus maxillosus* in a specific area is important for further improvement in estimating PMI, as well as forensic analysis in that area. Further studies are needed for other necrophagous insects with successional patterns in Yemen.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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