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A remarkable teratological specimen of
Trichiotinus rufobrunneus (Casey)
(Coleoptera: Scarabaeidae: Cetoniinae: Trichiini)

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Abstract. An unusual eye malformation observed in *Trichiotinus rufobrunneus* (Casey) (Coleoptera: Scarabaeidae: Cetoniinae: Trichiini), is described and illustrated. The functionality of the ectopic compound eye is discussed. According to label data, larval association with oak rotten log habitats is reported.

Key words. Teratology, morphology, Scarabaeoidea.

Resumen. Se describe e ilustra una malformación inusual en los ojos de *Trichiotinus rufobrunneus* (Casey, 1914). Se discute la funcionalidad de los ojos compuestos ectópicos. De acuerdo con los datos de etiqueta, se reporta la asociación de la larva con madera de roble en descomposición.

Palabras clave. Teratología, morfología, Scarabaeoidea.

Introduction

Morphological malformations are common in Coleoptera and have been widely documented (Mocquerys 1880; Ellis 1915; Balazuc 1948, 1969; Ortuño and Hernández 1993; Ortuño and Ramos-Abuín 2008; Castro-Tovar et al. 2014). Malformations are frequently reported in Carabidae, Staphylinidae, Cerambycidae, Chrysomelidae (Frank 1981; Gandhi and Herms 2008; Asiain and Márquez 2009; Ortuño and Peláez 2004; Clark and Belo-Neto 2010; Verdugo 2013; Verdugo and del Saz Fucho 2012; Verdugo and Toribio 2015, 2017) and in the superfamily Scarabaeoidea (see Gasca-Álvarez et al. 2017).

Several authors have reiterated the scientific importance of describing and illustrating insect abnormalities. They state that some cases can provide relevant information about environmental influences on developmental processes (Glasgow 1925; Cockayne 1937; Savini and Furth 2004; Clark and Belo-Neto 2010).

The origin of these developmental abnormalities has been difficult to establish. Some can be coded in the DNA and are transferable to subsequent generations. In some cases, malformations can be produced by the effects of a single gene, or are characterized by diverse phenotypic expressions that may involve multiple genes and their interactions with the environment (Clark and Belo-Neto 2010; Palomar-Morales et al. 2016). These abnormalities can be caused by the action of endogenous or exogenous factors that influence embryonic and/or postembryonic development. Virus infections or parasites, can be other factors associated with the occurrence of malformations.

Continuing documentation of the teratology of scarab beetles (see Gasca-Álvarez et al. 2017), we report herein a notable case in a male specimen of *Trichiotinus rufobrunneus* (Casey)

Materials and Methods

The male specimen is housed in the Florida State Collections of Arthropods (Gainesville, Florida, United States of America), and labelled: "FLORIDA: Levy Co. 3.8 mi SW Archer 23-III-1988. P. Skelley: reared from grub in rotten oak log". Photographs were taken using the AutoMontage system by Syncroscopy located at the Florida State Collections of Arthropods. Terminology follows Balazuc (1948, 1969) and Ortuño and Hernández (1993).

Results and Discussion

The specimen exhibits a well-developed third holoptic eye, smaller than the normal eyes and located in the frons, close to right eye (Fig. 1). The size and shape of the head, and the antennal insertion appears to be typical, compared with other normal specimens. This malformation is a new case reported in Scarabaeoidea. Other different cases involving eye malformations in Coleoptera have been described for two species of Chrysomelidae. In *Donacia bicolora* Zschach, a case of cephalic hemiatrophy produced the complete reduction of the right eye (Balazuc 1948). Clark and Belo-Neto (2010) found a female of *Pseudoluperus longulus* (LeConte) from Utah (USA), with the head surface covered almost entirely by a single holoptic eye.

This finding in *T. rufobrunneus* raises the question of whether this compound eye is a functional structure. Researchers at Indiana University (USA), demonstrated that the down-regulation via RNAi of *orthodenticle*, a single head patterning gene, results in development of functional ectopic compound eyes at the middorsal adult head of five scarab species (Zattara et al. 2016, 2017). The RNA sequencing experiments were performed on *Onthophagus taurus* (Schreber), *O. sagittarius* (Fabricius), *O. binodis* (Thunberg), *Digitonthophagus gazella* (Fabricius) (all Onthophagini) and *Liatongus militaris* (Castelnau) (Oniticellini). According to the authors, the ommatidial organization of these induced structures reveals the presence of rudimentary ommatidial lenses, crystalline cones, and associated neural-like tissue. To establish the functionality, a light-aversion behavioral assay demonstrated that these ectopic compound eyes have the ability to respond to visual stimuli when wild-type eyes are surgically removed (Zattara et al. 2016, 2017). In all scarab species studied, these ectopic eyes are located in the middle of the head.

This contrasts with the observed specimen of *Trichiotinus* Casey, where the third compound eye is not centrally located (Fig. 1b). According to the position of the third compound eye, its inner margin is somewhat in line with the lateral margin of the clypeus, similar to the position of the "normal" eye on the right side of the head. Moreover, the head is asymmetrical, the mouthparts are exposed and the "normal" eye on the right side is placed more lateral in regard to its regular position. Possibly, the apparent third compound eye is in fact a rudiment of the original right eye (Fig. 1c), which for an unknown reason stopped its development and a was replaced with a new one.

Little is known about the natural history of *T. rufobrunneus*. This flower chafer has a limited distribution in Florida and is likely restricted to oak scrub habitats (Hoffmann 1935; Philips et al. 2016). Adults have been reported as floral visitors or pollinators of the saw palmetto *Serenoa repens* (Bartram) Small (Arecaceae) (Deyrup and Deyrup 2012), *Asimina obovata* Nash (Annonaceae) (Gottsberger 2012) and *Opuntia* spp. (Cactaceae) (Eisner 2003). Larval feeding habits were not known until now. According to data label, the larvae of *T. rufobrunneus* fed and developed in rotting oak trunks. In some places in Florida, the populations are relatively abundant in the spring. When many *Trichiotinus* specimens are resting or when feeding on pollen within a flower, they take a position with the pygidium facing outward towards the flower's opening, thus giving it the appearance of the head of a bee or wasp (Ratcliffe 1991; Eisner 2003).

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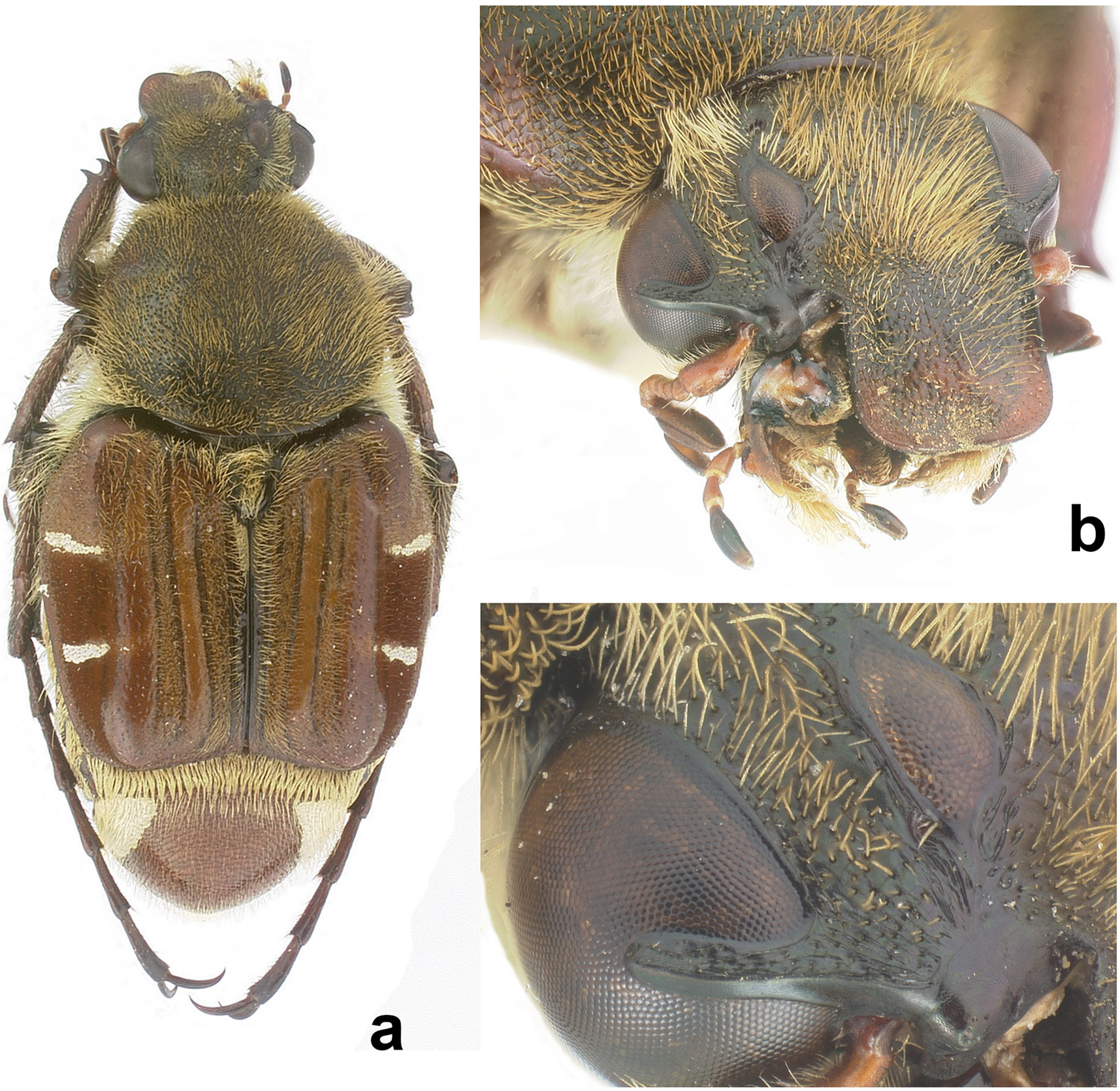

Figure 1. Teratological *Trichiotinus rufobrunneus* (Casey). **a)** Habitus. **b)** Head. **c)** Detail of third eye.