

## Research Article

**First report of *Rhantus validus* Sharp (Coleoptera: Dytiscidae) as necrophage and generator of *postmortem* artifacts in a human corpse found in an artificial freshwater pond from the Región de La Araucanía, Chile**

Primer reporte de *Rhantus validus* Sharp (Coleoptera: Dytiscidae) como necrófago y generador de artefactos *postmortem* en un cuerpo humano encontrado en un estanque artificial de agua dulce de la Región de La Araucanía, Chile

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**Abstract.** The forensic information of criminal interest that can be obtained from a decomposing human corpse can be harmed by *postmortem* changes. The presence of the water beetle *Rhantus validus* feeding on a corpse found in an artificial freshwater pond in Peñehue, Región de La Araucanía, Chile, and *postmortem* artifacts caused by their necrophagous activity is reported. These skin modifications can be confused with *antemortem* injuries. The ecological conditions that allow this feeding behavior and the forensic repercussions of this finding are discussed.

**Key words:** Aquatic Insects, facultative necrophage, forensic entomology, Neotropical Region.

**Resumen.** La información forense de interés criminalístico que se puede obtener desde un cuerpo humano en descomposición puede ser perjudicada por los cambios *postmortem*. Se reporta la presencia del díptero *Rhantus validus* alimentándose sobre un cuerpo humano encontrado en un estanque artificial de agua dulce en Peñehue, Región de La Araucanía, Chile, y los artefactos *postmortem* causados por su actividad necrófaga. Estas modificaciones en la piel pueden ser confundidas con heridas *antemortem*. Las condiciones ecológicas que permiten este comportamiento trófico y las repercusiones forenses de este hallazgo son discutidas.

**Palabras clave:** Entomología Forense, insectos acuáticos, necrófago facultativo, Región Neotropical.

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## Introduction

The decomposition process of animal carcasses in aquatic environments determines specific groups of arthropods associated with defined stages of this process (Payne and King 1972). The presence of aquatic insects in Forensic Entomology studies has not received sufficient attention, since these are not classified as carrion insects (Catts and Goff 1992; Vance *et al.* 1995; Wallace *et al.* 2008).

Currently, there is a paucity of literature concerning forensic entomology and decomposition processes in aquatic environments (Merrit and Wallace 2001; Magni *et al.*

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2008). In most cases, a body placed in water progresses through a series of sinking and/or floating phases (Haglund and Sorg 2002). During the early floating phase, necrophagous Diptera (Calliphoridae, Sarcophagidae, Muscidae, etc.) can colonize a body in the water, and some other aquatic or semiaquatic Diptera (Simuliidae, Chironomidae, etc.) can use the submerged body as an eventual source of food or as a substrate to attach to (Merritt and Wallace 2001). Among aquatic insects found in carcasses, the presence of diving beetles (Coleoptera: Dytiscidae) either as larvae or adults, has been associated with a predaceous role (Merritt and Wallace 2001; Lefebvre and Gaudry 2009; Barrios and Wolff 2011; Ramos-Pastrana *et al.* 2019), so they have not considered important in forensic analysis (Vance *et al.* 1995).

The aim of this work is to report the presence of *Rhantus validus* Sharp, 1882 adults feeding on a corpse found in a freshwater aquatic environment, to establish the relation between the morphology of the mouthparts of this diving beetle and the morphology of skin injuries observed, as well as to analyze the ecological context that this feeding behavior cause.

## Materials and Methods

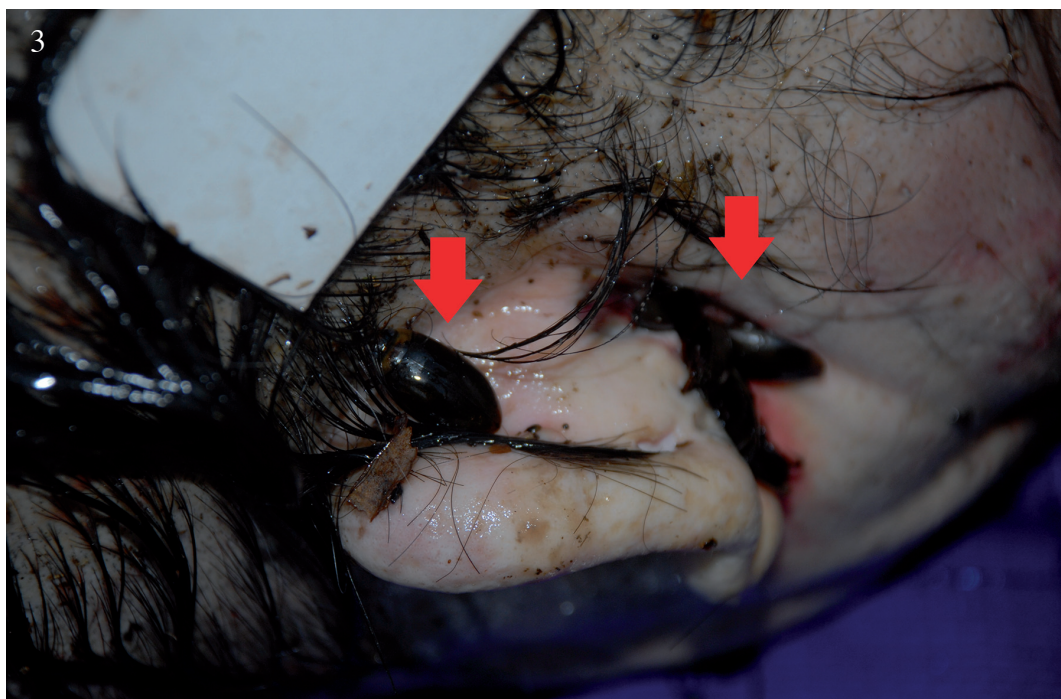
**Finding, forensic and medico-legal information.** On April 12, 2014, a corpse of 47 year-old man was found floating in an artificial freshwater pond in the locality of Peñehue (39°00'6,2" S - 73°04'37,0" W), Región de La Araucanía, Chile. The corpse was found less than 2 m from the shore, in the early floating stage (Payne and King 1972), and only his back and neck were exposed to the air (Fig. 1). The technical-scientific report provided by Chilean Investigate Police (PDI) officers and the autopsy Protocol performed by Medical-Legal Service's (SML) forensic examiners, which contain forensic and complementary medico-legal information respectively, were requested and reviewed. The cause of death was asphyxia by drowning.



**Figure 1.** A floating corpse of 47 year-old man found in Peñehue, Región de La Araucanía, Chile.



**Biological sampling and laboratory analysis.** When the body was removed from the water, four diving beetles (Figs. 2, 3) were collected from inside skin injuries by trained PDI officers, as per to entomological evidence collection protocol (Ortloff *et al.* 2014). Other species of arthropods or insects associated with the corpse were not observed. The collected diving beetles were conserved in ethanol (70%) and acetic acid solution (92:8), and identified through a review of insect collections in the Zoology Department at the Universidad de Concepción (UDEC) and the Agricultural and Forestry Sciences Faculty at the Universidad de La Frontera (UFRO) in Temuco. This was also complemented by the morphological analysis of the individuals and mouthparts under a Wild M3B stereoscopic microscope and the key of *Rhantus* Dejean, 1883 reported species for Chile (Moroni 1988) in the Forensic Entomology Laboratory at the UFRO.



**Figures 2-3.** 2. Adult of *Rhantus validus* Sharp. Dorsal and ventral view. Scale bar: 10 mm. 3. Two *Rhantus validus* adults (indicate with red arrows) associated to a *postmortem* artifact in left ear.

## Results and Discussion

The forensic studies about aquatic carrion insects can provide useful information about crime investigations (Catts and Goff 1992; Merritt and Wallace 2001; Wallace *et al.* 2008), and carrion beetles in particular are considered a wide source of potential forensic evidence (Smith 1986). In a broad sense, necrophagous activity can produce *postmortem* changes (Anderson 2010), which can be confused with *antemortem* injuries caused by a third-person, which could complicate the forensic analysis (Brown *et al.* 2001; Offelle *et al.* 2007; Midgley *et al.* 2010).

Two types of skin injuries were observed on the body: a) a channel behind the left ear approximately 30 mm long and 10 mm in wide (Fig. 3), and b) several oval chambers with regular margins and a maximum diameter of 10 mm on the face, arms and upper chest (Fig. 4). The morphology of these injuries is clearly related to an alteration by elimination of soft tissues (González *et al.* 2013), and were attributed to “necrophagous fauna” by SML forensic medical examiners, excluding *antemortem* injuries caused by piercing elements, without specifying what medical procedures were used for this conclusion.

The mouthparts of the Dytiscidae species are curved, heavily sclerotized and asymmetrical mandibles, with a cutting edge and a groove to release digestive enzymes (Wall *et al.* 2006), as well as maxillae with very sharp teeth in the lacinia, so it is consistent with the feeding action caused by these structures. The *R. validus* adults inside these skin modifications were fed directly from the epidermis and dermis (Figs. 3, 4), and as a result of this necrophagous activity, a new microhabitat with greater protection was generated, giving them to other carrion arthropods access to internal tissues (Magni *et al.* 2008).

Some aquatic insects can be facultative scavengers under specific ecological conditions (Merritt and Wallace 2001). The exclusive presence of *R. validus* adults in this finding and their facultative necrophagous behavior can be related to the ephemeral condition of this aquatic environment, which had no prey availability and received water only from rainfalls. Although *R. validus* larvae were not observed in this finding and have not been described in the literature as scavengers, it may be possible that under the ecological conditions noted above, these immature stages could have a similar feeding behavior, since there is a morphological similarity between Dytiscidae adults and larvae mouthparts (Alarie *et al.* 2009).



**Figure 4.** Two *Rhantus validus* adults (indicate with red arrows) associated to a *postmortem* artifact in upper chest.

The vagility of *R. validus* allows it to be present in many continental temporary and permanent pond, lake and river environments (Moroni 1988; Jerez and Moroni 2006), as well as artificial pools, so its presence in corpses could be used to link it with these environments. The presence of *R. validus* adults during the early stages of the aquatic decomposition of carcasses indicates a feeding preference for fresh soft tissues, and is consistent with the observations of other Dytiscidae species collected from pig carcasses in lakes in the Neotropical Region (Barrios and Wolff 2011; Ramos-Pastrana *et al.* 2019).

## Conclusion

The facultative necrophagous activity of *R. validus* adults causes *postmortem* artifacts in human bodies found in aquatic environments with no food availability. In Forensic Entomology studies, the analysis of collected or observed “predator insects and arthropods” is very important, especially when they have adequate mouthparts for feeding on carrion, and the decomposition process occurs in ephemeral environments. It is suggested that future studies should focus on the potential facultative necrophagous activity of predator fauna associated with carrion decomposition.

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