



First record of *Poecilochirus necrophori* (Acari: Mesostigmata: Parasitidae) from Turkey and its importance in forensic acarology

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ABSTRACT: *Poecilochirus necrophori* Vitzthum, 1930 is a Palearctic distributed species, which deutonymphs are phoretic on some burying beetles (Coleoptera: Silphidae). The mites use adult beetles for transport to carcasses where the deutonymphs moult into adults and both mites and beetles feed and reproduce. A life cycle of *Poecilochirus* species is synchronized with their phoronts and they can be used in a forensic acarology as indicators of post mortem interval. We present the first record of *P. necrophori* from Turkey. Phoretic deutonymphs of *P. necrophori* were found on the beetle *Nicrophorus vespillo* (L.) (Coleoptera: Silphidae) in Sakarya province. The deutonymphs were also found on carcasses of marten (*Martes* sp.) and mole (*Talpa* sp.) from Sakarya, Turkey. Moreover, a significance of *Poecilochirus* species in forensic acarology is briefly discussed.

Keywords: Parasitidae, *Poecilochirus necrophori*, phoretic mites, carcasses, Turkey

Zoobank: <http://zoobank.org/B0359A97-7806-4A39-889B-4540972977F6>

INTRODUCTION

Poecilochirus necrophori Vitzthum, 1930 is a phoretic mite species living in association with carrion and burying beetles (Baker and Schwarz, 1997). Adults can be found on animal and human carcasses, while deutonymphs are phoretic on adult beetles. Deutonymphs can also be found on the carcasses, until they attach to their phoront (Schwarz and Walzl, 1996). The deutonymphs of this species prefer a beetle *Nicrophorus vespillo* (L.) as a host, however, they can use different beetle species if their preliminary host is not available (Nehring et al., 2017). The nature of a relationship between *Poecilochirus* mites and their host beetles depends on a number of conditions and can vary from parasitic or competitive through commensal to mutualistic (Nehring et al., 2017; Sun et al., 2019).

Due to their specificity, abundance, diversity, and frequent occurrence on carcasses, *Poecilochirus* species are of great importance to be used as indicator species in forensic acarology (Perotti et al., 2009; Pérez-Martínez et al., 2019). Despite the knowledge regarding the presence of mites in corpses, and their role in the decomposition of carcasses for a long period of time, their importance in forensic research has only been recognized in recent decades (Braig and Perotti, 2009; Medina et al., 2013; Saloña-Bordas and Perotti, 2014; Saloña-Bordas and Perotti, 2019). The only way for *Poecilochirus* species to get to the carcass is a phoresy (Perotti et al., 2009). They can change hosts on the carcass and even feed and reproduce on the carcass when there is no host present. However, as the mites cannot move to new carrion on their own, the offspring must reach the phoretic stage before the corpse rots and must attach to new host insects (Schwarz and Koulianos, 1998). Therefore, mites reproduce much faster

than their carriers which makes them better timeline markers than insects in forensic research (Perotti et al., 2009).

Hyatt (1980) synonymized this species with *Poecilochirus carabi* G. et R. Canestrini, 1882 due to variability of characters (e.g. shape of a transverse sclerotized sternal band, size of dorsal shields, length of setae) used for identification of these species. However, subsequent studies (Müller and Schwarz, 1990, Schwarz et al., 1991, Schwarz and Walzl, 1996) have shown, that both species are behaviorally and reproductive isolated and Baker and Schwarz (1997) reviewed the taxonomic status of both species.

Poecilochirus necrophori is known from Europe and Asia (Karg, 1993), it is probably a Palearctic species with the same distribution as its main host *N. vespillo*, although it may accidentally be found on other silphid beetles (Springett, 1968). Canitz et al. (2021) found this species in Europe and Kazakhstan.

The aim of the current study is to report *P. necrophori* based on the materials collected on animal carcasses of *Martes* sp. (Carnivora: Mustelidae) and *Talpa* sp. (Eulipotyphla: Talpidae) and beetle (*N. vespillo*) for the first time in Turkey.

MATERIALS AND METHODS

Mites were collected from animal carcasses (*Martes* sp. and *Talpa* sp.) and from host beetle (*N. vespillo*). The mites and phoretic carrier were photographed on the spot with a camera (Nikon P610). Subsequently, the samples were preserved in 70% ethanol. The mite samples were kept in formaldehyde for 24 hours to be translucent, then identified under a Fluorescence Upright Microscope (Nikon Eclipse 80i). Photographs were taken with the Mdx4-t

model microscope camera. The measurements of setae, podonotum and opisthonotum were taken by the MShot Image Analysis System program.

Identifications of beetle and mites were done according to the keys published by Ciftci et al. (2018) and Mašán (1999), respectively. The specimens are deposited in the Parasitology Laboratory of Department of Parasitology, Faculty of Veterinary Medicine of Ondokuz Mayıs University (Samsun, Turkey).

Material examined: *Poecilochirus necrophori*, 25 deutonymphs phoretic on *N. vespillo*, 13.07.2019, Sakarya, 41°3'54.06"N, 30°39'19.00" E, altitude 60 m, leg. G. Eren; 11 deutonymphs on carcasses, ibidem, collected on animal carcasses (*Martes* sp. and *Talpa* sp.) and on beetle (*N. vespillo* that was feeding on carcass).

RESULTS

The phoretic deutonymphs of *P. necrophori* were found attached to the host beetle *N. vespillo* (Figs 1, 2). Deutonymphs of *P. necrophori* differ from other *Poecilochirus* species by having a dark sclerotized transverse band located in the area between setae st1 and st2 in the sternal shield (Fig. 1C). In addition, they also differ by the presence of a membranous process at the tip of cheliceral fixed digit (Fig. 1D) (Mašán, 1999). *P. necrophori* can be separated from its sibling species *P. carabi*, based on the length of dorsal setae and the opisthonotal shield (Fig. 1A) (Baker and Schwarz, 1997).

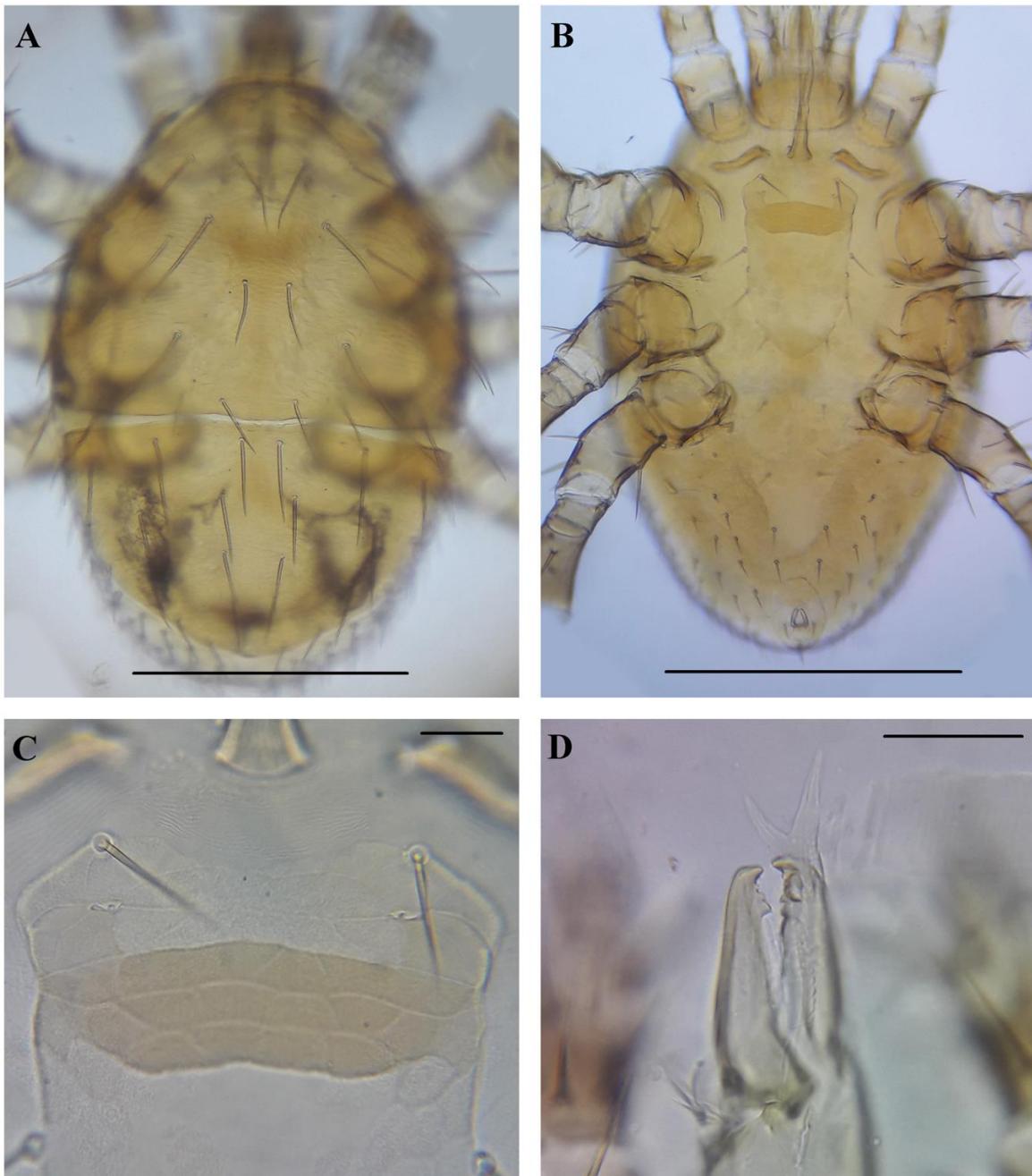


Figure 1. *Poecilochirus necrophori* (Deutonymph) **A.** Dorsal view, **B.** Ventral view (scale bars = 500 µm), **C.** Sclerotized transverse sternal bands (scale bar = 50 µm), **D.** Cheliceral digitus fixus (scale bar = 40 µm).



Figure 2. *Poecilochirus necrophori* (Deutonymph) on its phoront *Nicrophorus vespillo* (from the marten (*Martes* sp.) carcass).

DISCUSSION

Carcasses are dynamic and temporary ecosystems with a relatively short duration, which are attractive for different trophic groups of mites. All those mites had to develop strategies to migrate to new carcasses after the first one is reduced and the phoresy is one of these strategies. Most of the mites regularly found on carcasses belong to families Ascidae, Laelapidae, Macrochelidae, Parasitidae and Uropodidae and they can be used as indicator species in forensic studies (Pérez-Martínez et al., 2019). Over 100 species of mites associated with human and animal carcasses have been reported so far (Perotti et al., 2009). *Poecilochirus* species are one of the most abundant gamasid mites found in carcasses, however, different species may occur at the different stages of the decomposition (Pérez-Martínez et al., 2019; Saloña-Bordas and Perotti, 2019). Several *Poecilochirus* species (*P. austroasiaticus*, *P. carabi*, *P. davydovae* and *P. subterraneus*) have been already reported on human carcasses, *P. mrciaki* on a pig carcass, *P. necrophori* on a mouse carcass and *Poecilochirus* sp. on seal, rat and rabbit carcasses (Lord and Burger, 1984; De Jong and Chadwick, 1999; Braig and Perotti, 2009; Medina et al., 2013; Saloña-Bordas and Perotti, 2014; Saloña-Bordas and Perotti, 2019).

In this study, the mites were collected together with *N. vespillo* feeding from marten (*Martes* sp.) and mole (*Talpa* sp.) carcasses, as well as mites walking directly on the carcass.

The observations and measurements of collected specimens are in agreement with those reported by Baker and Schwarz (1997) (Table 1). In addition to morphological and molecular methods (which couldn't be used in this case due to the fact that our material was processed in formaldehyde), behavioral methods can be used to identify this species among others *Poecilochirus* species. Many studies (Müller and Schwarz, 1990, Schwarz et al., 1991, Nehring et al., 2017, Canitz et al., 2021) have confirmed that the species *P. necrophori* is specialized to the beetle species *N. vespillo*, on which our individuals were found.

Table 1. Length of dorsal setae and dorsal shields of *Poecilochirus necrophori* (Deutonymph)

Seta / shield	Range (µm)	Mean
Z1	150-150	150
s4	160-180	167.5
J1	110-135	134.5
s5	150-165	152.7
z5	260-280	272
r3	350-365	353
opisthonotum	420-475	449.5
podonotum	575-600	595

Till now, only four *Poecilochirus* species were known and described from Turkey (Ramaraju and Madanlar, 1998). None of them was found on the carcass and none of these species possesses apomorphies, which are characteristic for *Poecilochirus* deutonymphs. These characters include the sternal shield with the sclerotized transverse sternal band and the membranous process at the tip of the fixed digit of chelicerae (Hyatt, 1980).

In the present study, *Poecilochirus* mites are evaluated in terms of forensic acarology in Turkey and *P. necrophori* is reported from Turkey for the first time. Additionally, further studies are essential in order to obtain more detailed knowledge for the use of these mites in forensic acarology in Turkey.

Authors' contributions

Kamila Ondřejková: Conceptualization (equal), data curation, formal analysis (equal), resources (equal), visualization (equal), writing - original draft (supporting), writing - review & editing (lead). **Gökhan Eren:** Conceptualization (equal), investigation, formal analysis (equal), methodology (equal), resources (equal), visualization (equal), writing - original draft (lead), writing - review & editing (supporting). **Mustafa Açıcı:** Conceptualization (equal), methodology (equal), supervision, visualization (equal), writing - original draft (supporting), writing - review & editing (supporting).

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Conflict of interest

The authors do not have conflict of interest.

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