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First record of *Necrobia rufipes* (De Geer, 1775) (Coleoptera: Cleridae) from Khuzestan Province, southwest of Iran, a beetle species of forensic importance

Mohammad Reza Fakoorziba¹, Mohammad Assareh^{1*}, Davood Keshavarzi², Aboozar Soltani¹, Mohammad Djafar Moemenbellah-Fard¹, Mohammad Zarenezhad³

¹Research Centre for Health Sciences, Department of Medical Entomology and Vector Control, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran

²Department of Medical Entomology and Vector Control, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran.

³Legal Medicine Research Centre, Legal Medicine Organization, Tehran, Iran.

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ABSTRACT

Objective: To introduce *Necrobia rufipes* as a forensic important species in the study area.

Methods: This study was performed using a laboratory bred rat (Wistar rat) weighing 352 g as a model for decomposition. The rat was killed by contusion and placed in a semi-desert location. Observations and collections of beetles were made daily during May to July 2015.

Results: Decomposition time for the rat lasted 38 days and *Necrobia rufipes* was seen in the bloat to decay stages of body decomposition.

Conclusions: The species of beetle found in this case could be used in forensic investigations particularly during the warm season in future.

1. Introduction

Forensic entomology is the application of the scientific study of cadaveric insect and other arthropods to medico-legal subjects in the judicial system[1]. The study of carrion beetles is important in the forensic entomology field. This can be useful in determining post-mortem interval (PMI) and also acquiring information about the site of death[1,2]. Insects have a specific pattern to attack the bodies as carrion beetles are generally found in the late phases of body decomposition[3]. Two main groups of insects, the flies and the beetles, are mostly attracted to corpse and provide valuable evidence in criminal investigation[1]. The entomological technique

to determine the time of death consists of two main measures: the estimate based on the age of the oldest maggots that have developed on the body and estimate based on the development patterns[4].

The order Coleoptera comprises a number of forensically important families, viz. Silphidae, Staphylinidae, Nitidulidae, Scarabaeidae, Dermestidae, and Histeridae[5]. Cleridae is a small family with approximately 3 600 identified species. They are predators and feed on other insects in the adult and larval stages[6]. The legs are unique (tarsal formula is 5–5–5) and front coxae exposes the second segment of the legs known as the trochanter[7]. The Cleridae family are predators of insects that live in animal excrement, carrion and vegetable material[8,9]. Hence, they have been indicated to be important in certain criminal investigations[10]. The predacious beetles will feed on the numerous insects on the body, predominantly Diptera. To estimate the PMI, forensic investigators must look at the insects on the body and determine the time of colonization, so if the Cleridae beetles are existent, the explorer can assume that some of the other insects have been eaten by these beetles[11].

*Corresponding author: Mohammad Assareh, Research Centre for Health Sciences, Department of Medical Entomology and Vector Control, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran.

Tel: +98 916 3037594

Fax: +98 713 7260225

E-mail: mohammadassareh92@gmail.com

All experimental procedures were carried out in accordance with the National Institution of Health guide for the care and use of laboratory animal, and approved by the Animal Welfare Ethical Committee of Shiraz University of Medical Sciences.

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2. Materials and methods

2.1. Study site

The study was carried out in a riverside location in Ahvaz City, Iran. Ahvaz is the capital of Khuzestan Province, located in the southern part of the country and bordering Iraq and the Persian Gulf (Figure 1). The climate of Khuzestan is generally very hot and occasionally humid, particularly in the south, while winters are much more cold and dry. Summertime temperatures routinely exceed 48 °C and in the winter can drop below freezing temperature, with occasional snowfall, all the way south to Ahvaz. The averages of minimum and maximum temperatures at the time of this study for each decomposition stage are shown in Figure 2.

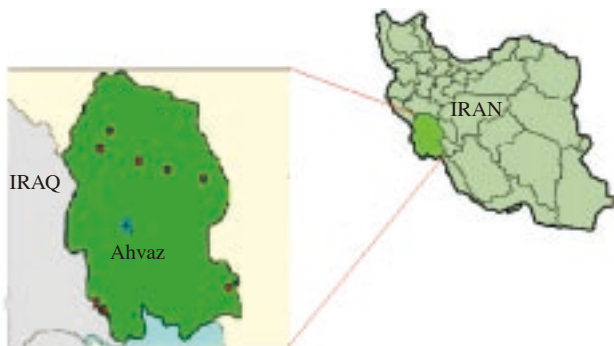


Figure 1. Map of Khuzestan Province, southwest of Iran.

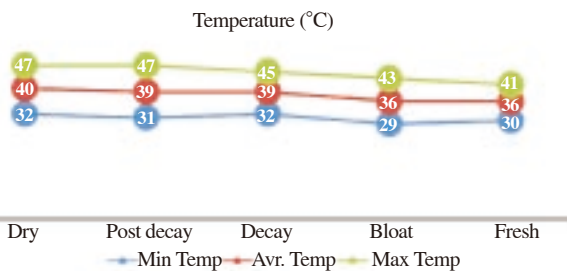


Figure 2. Changes in maximum and minimum ambient temperature between fresh and dry stages, Ahvaz City, May to July 2015.

2.2. Study animal and insect collection

This study was carried out using a laboratory bred rat (Wistar rats) weighing 352 g as a model for decomposition. The rat was killed by contusion and placed in a semi-desert location. All experimental procedures were carried out in accordance with the National Institution of Health guide for the care and use of laboratory animal, and approved by the Animal Welfare Ethical Committee of Shiraz University of Medical Sciences. Observations and collections of flies and beetles were made daily during May to July 2015. Adults of beetle were collected from the carrion during the night. A valid taxonomic key was used for the identification of beetle species[12]. In this study fly maggots were collected with forceps. Larvae were collected and divided into two groups; some immature individuals were killed in hot water and stored in 70% alcohol, while others were transferred to the laboratory of entomology for rearing.

The live larvae were reared on blood agar media in a thermostatic room (Figure 3). The adult flies were killed with ethyl acetate

and then pinned with entomological pins for identification. Valid taxonomic keys were used for the identification of different species[13].



Figure 3 Larvae of Diptera species reared on blood agar media.

3. Results

Two orders of carrion-dwelling insects: adult beetles (No. 7) in the family of Cleridae (Coleoptera) and fly maggots of the dipterous family Calliphoridae (typically species of *Chrysomya albiceps*) were collected from the body. Decomposition time for the rat lasted 38 days, from May to July, 2015. *Necrobia rufipes* was seen in the bloat to decay stages of body decomposition (Figure 4). Highest number of this species caught occurred in the decay stage.

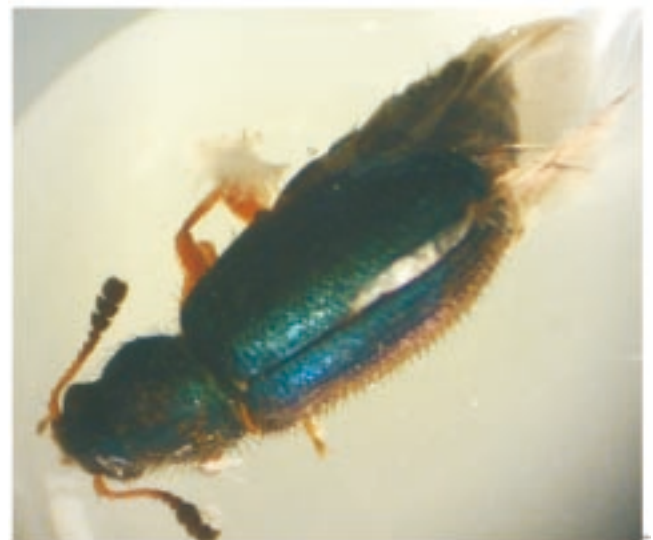


Figure 4. The habitus of *Necrobia rufipes* (Cleridae family).

4. Discussion

Since insects live on decomposing body tissues both as a food source and as a natural environment to develop to their next stages, they can skew the validity of the estimated PMI[2].

Forensic entomology is a neglected field among forensic sciences in Iran. Therefore, research in this field is essential. This is the

first documented report of insect evidence from a rat model for decomposition in the city of Ahwaz, south of Iran, and the main aim of this study was to introduce *N. rufipes* on a rat carrion as an important species during spring and summer seasons in the study area. The species *N. rufipes* is commonly known as the copra beetle in tropical countries and red-legged ham beetle in the United States. The adult beetle is greenish blue with legs and bases of the antennae reddish brown and it is 3.5 to 7 mm long[14,15]. *N. rufipes* has been recorded from carrions in China[8,16]. A study in Central Europe showed that this species mainly bred in open habitats and rarely bred in forests[17]. In Central Europe this species bred in cadavers from spring to summer[18]. This result is similar to our finding. *N. rufipes* can act as a forensic entomologic marker for the site of death when a human corpse was found. Some species of Calliphoridae family associated with carcasses were found in Iran[19-21]. Three families of beetles (Histeridae, Dermestidae and Staphylinidae) were isolated from a human corpse in Fars Province, south of Iran[22]. This species previously was recorded from few provinces in Iran, including Golestan, Hormozgan, Kerman, Sistan and Baluchestan[23,24]. A total of 48 species and 1 subspecies in 14 genera belonging to 4 subfamilies of Cleridae were recorded from Iran[25].

The life cycle varies from 36 to 150 days or more depending on the types of food and temperature[14]. Based on our observations, this insect feed on the insects that are present on the body. Therefore, in forensic entomology studies, behavior and food habits of *N. rufipes* should be considered.

This beetle species is active in bloat to decay stages of body decomposition and can be helpful for the development of forensic entomology in Iran. For estimation of PMI using this beetle in Iran, it is important to study the rates of development of instars and adult stages of this species. Future research will be needed on the biology of *N. rufipes*, in order to determine the exact length of each life cycle stages, which will be of great value to the further improvement of the PMI estimation and other forensic implications.

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Conflict of interest statement

We declare that we have no conflict of interest.

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