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Use of beetles in forensic entomology[☆]

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Abstract

Beetles (Coleoptera) have been recognised as providing significant entomological evidence in the medico-legal field, particularly with reference to dry human skeletal remains in the later stages of decomposition.

The Dermestidae (skin beetles) and Cleridae (bone beetles) have been found as the most common types infesting exposed human remains and providing evidence in estimating the minimum postmortem interval (PMI). © 2001 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Insects; Beetles; Postmortem interval; Forensic entomology

1. Introduction

Over the last decade, there has been a resurgence of interest in the estimation of postmortem interval (PMI) by entomological methods. Although, various combinations of data from laboratory rearings of selected species and data from decomposition studies have been used, remarkably, the majority of work which has been reported, concerns the insect fauna which infests the human corpses recovered in earlier stages of decomposition (i.e. within first weeks). We have already established that during this period, flies of the families Calliphoridae, Sarcophagidae and Muscidae are the prominent postmortem invaders [1,2]. However, little knowledge is available at present about the insect fauna encountered on corpses in the later stages of decomposition (i.e. within first 3–6 months).

No doubt, in such cases, particularly where dry human skeletal remains are recovered in the later stages of decomposition, the Coleoptera or beetles comprise, the main entomological evidence for the determination of PMI in the forensic field which is being based primarily on a succession pattern.

It is said that there are about six times as many species of insects as there are all other kinds of animal combined.

Stated differently, about 80% of all known animal are insects. It is generally believed that somewhere between 625,000 and 125,000 different kinds of insects have been named and described [3].

Of the many different kinds of insects, the beetles form the largest group. It is believed that over 600,000 have been described [3]. The Coleoptera contains many groups of significance in forensic studies. The main families among them being Staphylinidae, Scarabaeidae, Carabidae, Histeridae, Silphidae, Dermestidae [4].

In an interesting case study, the beetles (as insect remains) recovered from archaeological sites have provided potentially useful information about human burials. The fragmented insect parts have been recovered during excavations of Mashantucket Pequot Cemetery, Ladyard, CT. Dirrigl and Greenberg [5] have identified the remains of rove beetles (Coleoptera: Staphylinidae) and dung flies (Diptera: Scathophagidae) using natural history information about these insect families they formulated some generalisations about the association of insects with human bodies, season and period of interment, local habitat and taphonomy of the burial. Forensic anthropologists and medical examiners depend on identifying the stages of growth of insects to interpret the passage of time since death when examining the human remains [5].

Recently, the DNA (RAPD) typing of necrophagous insects (flies and beetles) has been successfully used in criminal forensic practice [6].

[☆]The present paper highlights the two case histories reported in 1998.

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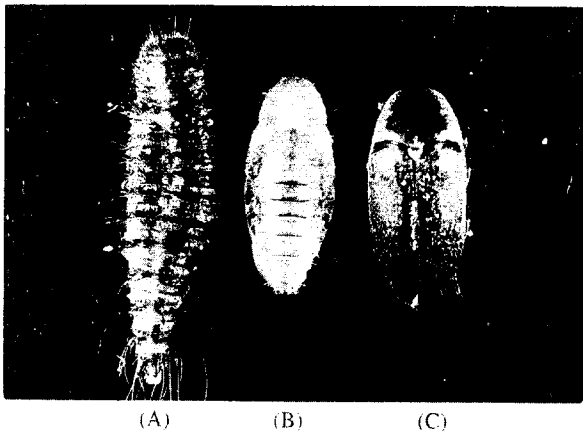


Fig. 1. *D. maculatus* De Geer (Dermestidae), (A) larva; (B) pupa; (C) adult.

The beetles of value as evidence on corpses are represented by two main families and species:

1. *Dermestes maculatus* De Geer commonly known as the skin beetle (family Dermestidae) (Fig. 1).
2. *Necrobia rufipes* De Geer (family Corinetidae or Cleridae) commonly known as bone or checkered beetles (Fig. 2).

The Dermestidae are generally small in size, the largest species measures 0.8 mm in length. They are usually oval, chunky beetles with pale grey or brown markings which are formed of minute scales. When disturbed, they roll over on their backs with their legs folded and lie still feigning death [3].

Dermestid larvae are hairy and sometimes called “woolly bears”. The hairs have urticating properties and care should be taken while handling the larvae so as not to inhale hairs or get them in the eye [7].

Dermestid female lay up to 150 eggs from which small hairy larvae hatch within about 3 weeks. The larval stages last from 5 to 15 weeks depending on temperature and type

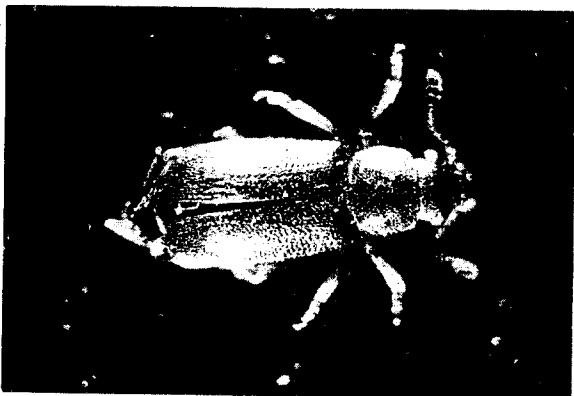


Fig. 2. *N. rufipes* De Geer (Cleridae) — adult.

of food available. The pupal stage lasts 2 weeks–2 months and beetles that emerge towards the end of year overwinter in the pupal shell and emerge the following spring [7].

Dermestes first appears during Megnin third wave when the fats are rancid after some 3–6 months [7].

The second most common group of beetles belong to family Corinetidae or Cleridae. The members of this family are known as “bone beetles” because they are usually found on carrion after most of the flesh has been, removed, presumably feeding on other insects rather than on the carrion itself. They were once included in the Cleridae, which they closely resemble, but were later separated and placed in a family of their own. However, there are some authors who would like to return them to the Cleridae and some of them have already done so. *N. rufipes* (red leg ham beetle) length 3.5–6 mm, metallic blue or green, shining, antennae dark brown, legs reddish brown [3].

Payne and King found that *N. rufipes* De Geer fed only on carrion and was found on the dry bone pig baits [7].

2. Case studies

2.1. Case study I

A deceased female aged about 18 years went in to a forest on 26 May 1998, and did not return. The police recovered her remains on 28 May 1998. An autopsy was conducted at district level and the autopsy surgeon could not ascertain any cause or nature of death. Subsequently, the remains were referred to the Medicolegal Institute on 16 June 1998. During examination, the skull, mandible, and other bones were found to be of human in origin and showing characteristics of the female sex. Injury was present on the skull which has been caused by hard or sharp object and ante-mortem. Hence, the cause of death determined was homicidal in nature.

2.1.1. Entomological evidence

We conducted our entomological examination on 18 October 1998. As the date, the last time the deceased person was seen alive was known, it was possible to determine in this case development time of the beetle fauna present.

The entomological evidence recovered from the remains represented two families of Coleoptera (1) adults, pupae and larvae of *D. maculatus* De Geer (Dermestidae) and (2) adults of red legged ham beetle *N. rufipes* De Geer (Cleridae). The prevailing environmental average temperature was 20°C and the average humidity was 46%.

2.2. Case study II

On 21 July 1997 remains of an unknown human female were referred to the Medicolegal Institute. The remains comprised: skull, mandible, hipbones, sacrum, scapula, femur, tibia, fibula, humerus, ulna and ribs.

On 12 January 1998 we examined the remains. We found that the bones were of human origin and belonged to the same individual female who was aged about 35 years. The skull was showing multiple sharp cut effects caused by a hard and blunt heavy object. If they had been inflicted during life, they were sufficient to cause death and such death was homicidal in nature.

2.2.1. Entomological evidence

A small number of adults of *D. maculatus* and adults of *N. rufipes* were collected from the remains. No beetle larvae or pupae were observed; however some larval cases of Dermestidae were present. The prevailing environmental average temperature was 16.5°C and average humidity was 71%.

3. Discussion

Anderson and Vanlaerhoven [8] observed that Dermestidae larvae were first found 21 days after death in the early stages of advance decay, when some flesh still remained, although more were collected after 43 days postmortem interval. A few adults were collected from as early as 3–5 days after death and 10 days after death but larvae were not reported [9] hence it should be borne in mind that the mere presence of a few adults on corpses does not represent the actual species infestation on remains. It is likely that they may have come from a near by habitat and only the presence of larvae colony represents an actual species infestation that can be used for PMI. A study of insect succession on carrion in Canada states that Dermestidae were not collected on human remains until 3–6 months after death [8].

Similar findings were found in case II that adults of *D. maculatus* and adults of *N. rufipes* present on the unknown female remains lead to an estimate of PMI of about 3–6 months since the date of observation (i.e. 12 January 1998).

The entomological findings in case I also confirm that adults, pupae and larvae of *D. maculatus* and adults of *N. rufipes* were present on female human remains with a PMI of 133 days i.e. 4 months and 13 days (well within in the range of 3–6 months). However, these findings further corroborate that Dermestid beetle pupae may be present usually on remains having 4–5 month PMI.

Goff and Flynn [10] reported a case study in which they observed the presence of *D. maculatus* and adults of *N. rufipes* on the remains of a male, 23 years old recovered from a sandy area near the ocean, Oahu, Hawaii. They have established PMI of 34–46 days.

Adult Cleridae were collected early in decomposition but larvae were not collected until the dry remains stage 94 days after death. Previous reports confirm these observations, although larvae were rarely collected in most previous

studies. Necrobia species are thought to differ from the general Cleridae feeding habits and subsist primarily as scavengers [8].

4. Conclusion

The present study emphasises the role of beetles (Coleoptera) in forensic entomology particularly with reference to remains recovered in the later stages of decomposition.

Among beetles, we have observed that two families: (1) Dermestidae (skin beetles) Cleridae (bone beetles) represent the main entomological inhabitants on the corpses in Bhopal and the nearby area. However, beetle colonisation may vary according to geographical regions. Hence, more systematic studies related to beetle infestation on human remains should be conducted by forensic entomologists during the routine medico-legal examinations of skeletal human remains on a world wide basis.

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