

# Succession of forensically important Coleopterans from Southern Rajasthan: A preliminary study and their forensic relevance.

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## Research Article

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# Abstract

Identification and knowledge of biology of insects is an initial and crucial step of using entomological evidence in forensic investigations. This preliminary study makes a strong platform for the importance of beetles (Order- Coleoptera) in forensic investigations.

**Methods:** - The work reported here monitored the presence of the beetles by using bait traps with the goat meat (*Capra* sps. Bovidae) and laboratory mice, and also collected from decomposed animal bodies from various locations of different studied area.

**Result:** - The main Coleopteran beetles collected from carcasses were *Dermestes maculates* (Dermestidae- carpet beetle), *Necrobia rufipes* (Cleridae- checkered beetle), and *Saprinus planiusculus* (Histeridae-clown beetle).

**Conclusion:** - The Coleopteran insects studied here can be considered as strong clues for forensic investigations and also to detect the nature of crime with the help of biology and succession study of forensic insects.

## Background

Forensic entomology is a new and emerging branch of science which is applicable to civil and criminal investigation with the help of insect's biology. Forensic entomology has been categorized in three sections such as medico- legal forensic entomology, urban forensic entomology and stored product forensic entomology. Medico legal forensic entomology has much beneficial role in solving the judicial and criminal activities and detects the nature of crime. Hundred of arthropods species are attracted to a decaying corpse, primarily flies (Diptera), beetles (Coleoptra) and their larval stages, but mites, Isopods and Nematodes can also be found. Dipterans and Coleopteran are attracted to the corpse and colonize in a sequence called the entomo-faunal succession and these succession patterns are helpful in estimating the Post Mortem Interval (Megnin, 1894, Putman, 1983 & Schoenly et al., 1987 and Marchenko 1988, 2001).

Some Diptrean Flies and Coleopteran beetles feed, live or breed on the corpse, depending on their biological preferences and on the state of decomposition. Arthropods are most vital and important biological groups on earth, they can be found in various habitats, locations including crime scene indicator by presence on carcasses. Crime solved by arthropod fauna forms the basis of investigation of insects collected from crime scenes and decomposed bodies (Benecke, 1998). Forensic entomology is an applicable tool to determine the time duration between death and discovery of a body (known as post-mortem interval or PMI), where the sequence of appearance of different groups of insects from body is recorded (Smith 1986, Anderson 1996). Family Calliphoridae and Sarcophagidae (Order Diptera) are early arrival and colonize on a corpse represent one of the most reliable means of estimating minimum postmortem interval (PMI<sub>min</sub>), whereas an insects from order Coleoptera arrive on carcasses in later stage of decomposition.

Beetles have been found to be the main entomological evidence present in a corpse in advanced decomposition stages and their usefulness to estimate the minimum Post Mortem Interval (PMI) has been emphasized (Kulshrestha and Satpathy, 2001). Kulshrestha and Satpathy (2001) explained the utilization of beetles in medico-legal entomology and report that Dermestidae (skin beetles) and Cleridae (bone beetles) were most common entomo-fauna found on human remains and providing evidence in estimating the minimum post mortem interval (PMI). The diversity of Coleopteran fauna increases during advanced stages of decomposition in open environment but absent or less represented in indoor corpse (Goff 1991). Since Coleopterans are showing presence in the later stages of decomposition, which is very important in terms of the dry bones of the body for detecting the criminal investigations (Zhuang et al. 2011)

Families of Coleoptera such as Dermestidae, Carabidae, Silphidae, Leiodidae, Staphylinidae, Histeridae, Cleridae, Anthicidae, Nitidulidae, Rhizophagidae, Ptinidae, Tenebrionidae, Scarabaeidae, Geotrupidae and Hydrophilidae, Trogidae (Smith 1986, Byrd and Castner 2009). Carrion beetles (Silphidae) have almost 200 species of forensic importance at worldwide distribution (Sikes, 2008). Carrion beetles can provide valuable information about postmortem interval and locations and cause of crime (Smith, 1986; Haskell et al., 1997; Watson et al., 2005).

An Udaipur district of South Rajasthan India completely lacks knowledge on the importance of Coleopteran fauna in forensic entomology, their succession and seasonal dynamics. Hence the present study would be of great practical importance for forensic purpose. The preliminary research will make a data of forensic important beetles from studied bioclimatic zone

## Methods

**Site Description:** - The present study was conducted in Udaipur district of South Rajasthan ((Fig: - 1) lies in between 24'58"N and 73' 68" E at 598 meter above sea level). Area Selection was based on the population density of the urban, rural and peri urban areas.

**Sampling Procedure:** - The study was carried out with the help of goat liver, the dead animal bodies (i.e. dead animals either observed from different sites like roads, dumping yards, etc, or fresh flesh collected from the butcher shop so not any type of animal was killed and also not use any living animals), goat liver use as a model animal for sample collection (Assaech et al. 2007). For sample collection, goat liver was put in cage and hung in various sites of studied areas. All the Specimens were picked up by forceps and brush from animal carcasses (Fig: -2) and collection of beetles were done twice a day like morning and evening, till the day of skeletonization of the carrion. Climatic factors i.e. temperature and relative humidity were recorded during the experiment by portable thermo hygrometer. Collected specimens were stored in 70% alcohol in glass vials in laboratory for the identification.

## Identification

Identification of Coleopteran beetles were done by using the key of (Peacock 1993, Ruzicka & Schneider 1996, 2002, 2011 and Ruzicka et al. 2000, 2011, 2015), and photography was done with the help of Lieca Stereo zoom microscope for further identification.

## Results

During the experiment three different families of order Coleoptera were collected from carcasses and model animals. They were (Fig: – 3. A) *Necrobia rufipes* (Cleridae- checkered beetle), (Fig: – 3. B) *Dermestes maculates* (Dermestidae- carpet beetle), and (Fig: – 3. C) *Saprinus planiusculus* (Histeridae- clown beetle) as seen on carcasses. *Dermestes maculates* and *Necrobia Rufipes* were showing high richness and *Saprinus planiusculus* having less abundance on the decomposed sites.

*Necrobia rufipes* (Fig: – 3. A) The adult beetles are 3.5–7.0 mm in size, and shiny metallic green or greenish blue in appearance & legs and antennae are red. *Necrobia rufipes* feed on the meat-infesting larvae of blow flies and animal carcasses (Hains and Rees 1989).

*Dermestes maculates* (Fig: – 3. B) Adults range in size from 5.5 to 10.0 mm and white hairs present on each side of thorax while abdomen shows black and white spots. Each side of the thorax has a band of white hairs (Haines and Rees 1989). Carpet beetle prefer decomposing remains of human and other decomposed animal bodies as a habitat and food source so presence of carpet beetles on decomposed body helpful in estimation of postmortem interval (Richardson and Goff 2001).

*Saprinus planiusculus* (Fig: – 3. C) Body size is 2-7mm species and pronotum have very small punctures. *Saprinus* species are found on carrion and dung. Appearance on animal carcasses is showing its utility in PMI estimation (Yelamos 2002).

## Discussion

Forensic entomology relies on insects and other arthropods as a tool for the acquisition of useful information in an investigation associated with legal issues (Keh 1985, Catts & Goff 1992). Flies locate the corpses earlier than beetles and that is the main reason why they prefer as a PMI detector in early stage of death and beetles in later stage of decomposition. When a corpse is colonized by the insects there are generally two situations; first where PMI is estimated by determining the age of oldest specimen found on the body or death scene, and second by necrophagous insects found in decomposition. (Amendt et al. 2007). The estimation of the PMI is only possible by analyzing the chronological succession (Lefebvre & Gaudry 2009). *S. planiusculus* of forensically important species has been observed from carrions in Poland and Turkey (Matuszewski et al. 2008). A study conducted by Mise et al. (2007) observed the Coleoptera of forensic importance from pig carcasses till one year and found 4,360 beetles belonging of 112 species from 26 families, in that 12 families were considered of forensic potential.

Family Dermestidae are showing appearance as stored pest in human environments and in cases of mummification of a human corpse indoors, they can accelerate the process of skeletonization. According to a case study dermestidae beetles were found from a human corpse of 66-year old former sailor's body, from his living room (Schroeder et al.2002). Forensically important families of order Coleoptera: Dermestidae (*Dermestes maculatus*), Histeridae (Hister sp.) Cleridae (*Necrobia rufipes*) were recorded from the pig carcasses at Phitsanulok, northern Thailand by Vitta et al. 2007). And *Saprinus*, *Necrobia rufipes* & *Dermestes* species were observed from rabbit carcasses (Mabika et al. 2014)

Seven species of Silphidae were reported from pig carcasses of forensic implications, they were three species isolated from Nicrophorinae: *Nicrophorus humator*, (Gleditsch), *Nicrophorus vespillo* (L.), *Nicrophorus vespilloides* (Herbst) and four Silphinae: *Necrodes littoralis* L., *Oiceoptoma thoracica* L.; *Thanatophilus sinuatus* (Fabricius), *Thanatophilus rugosus* (L.) in spring season at urban, forest and agricultural biotopes of Western Europe (Jessica Dekeirsschieter et. al 2010)

Singh and Madhubala (2017) recorded the carrion beetles (Coleoptera: Silphidae) by using bait traps goat meat (*Capra* sps., Bovidae) in 2014, 2015 during the summer season from Himachal Pradesh and Punjab states of India, and observed Seven species of Silphidae of forensic importance were :-*Necrophila (Calosilpha) ioptera* (Kollar & Redtenbacher, 1848), *Necrophila (Deutosilpha) rufithorax* (Wiedemann, 1832), *Necrodes littoralis* (Linnaeus, 1758), *Necrodes nigricornis* (Harold, 1875), *Nicrophorus nepalensis* (Hope, 1931) and *Thanatophilus minutus* (Kraatz, 1876), *Necrophila (Calosilpha) cyaniventris* (Motschulsky, 1870), .

## Conclusions

Insects have multiples role in environment such as establish the equilibrium in ecosystem apart from it insects are important limestone for medico-legal forensic entomology. The study provide preliminary data of insects fauna from carcasses that Dipteran flies of Calliphoridae and Sarcophagidae are arrive in early stage of decomposition so initially detection can be done with the help of biology of these flies but later stage of decomposition can be done with beetles (Coleoptera), beetles prefer decomposed body as a food source and habitat so evaluate the succession pattern of beetles from carcasses forensic entomologist easily detect the PMI.

This is the pioneer research conducted to study the beetle succession on carrion in Southern Rajasthan specifically. *Dermestes maculates* show high richness on carcasses, *Saprinus planiusculus*, *Necrobia rufipes* and *Dermestes maculates* are widely studied on carcasses in studied area because of their forensic utility.

The presence of such species that has cosmopolitan distribution favor their forensic relevance, but lack of their developmental data is the primary hurdle in using these for the estimation of postmortem interval. The study would be beneficial for provide a platform for legal investigations with the help of insects fauna.

# Abbreviations

PMI Post-Mortem Interval

# Declarations

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**Authors Contribution:** - All authors have participated in-

1. Arti Prasad: - conception, experiment design, data interpretation and analysis.
2. Sanjay Kumar Meena: - field survey, data collection and data interpretation and analysis.

### **Availability of data and material: -**

1. The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.
2. All data generated or analysed during this study are included in this published article [and its supplementary information files].

**Competing interests:** - Not applicable.

**Clarification of Image:** - The Figure 2 was of the author (Sanjay Kumar Meena) and the photograph was taken during the collection of beetles, because collection of beetles from surveyed area should be require for identification and further forensic purpose.

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## Figures

Figure: Map of Sampling sites for the study

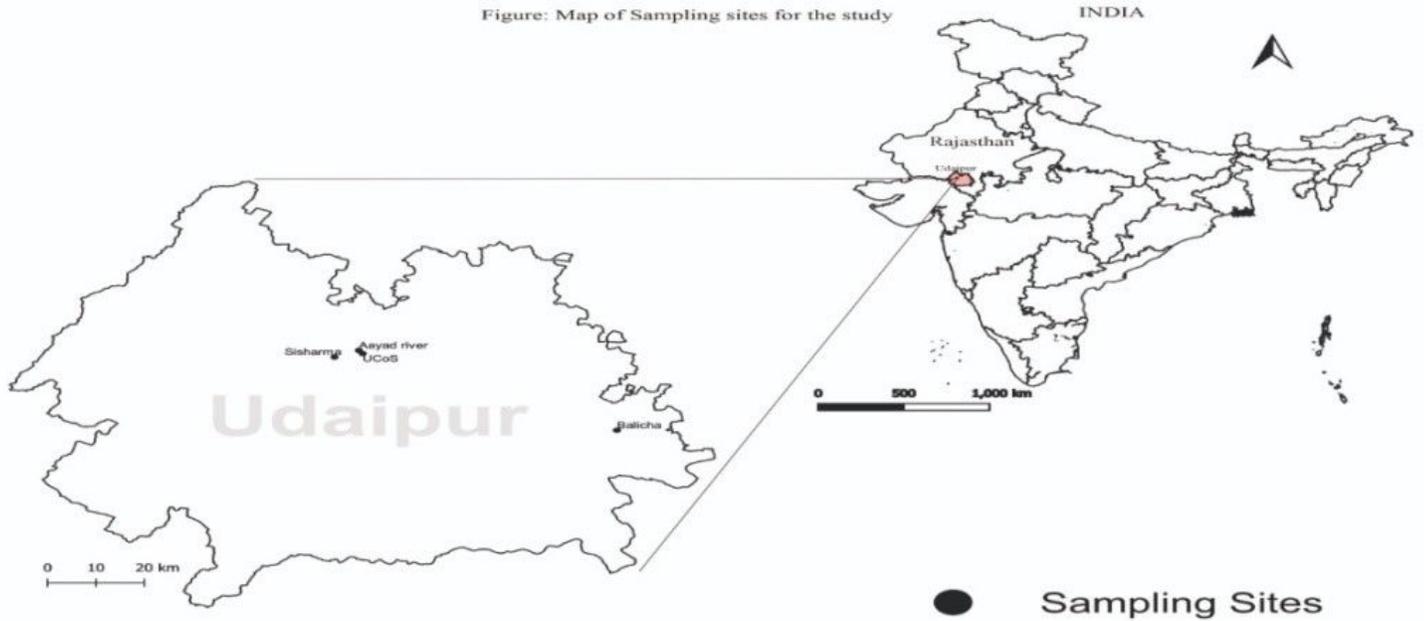


Figure 1

Map of sampling sites for study



Figure 2

Collection of Beetles from Carcasses



(A)



(B)



(C)

### Figure 3

Collected Beetles from Studied area

(A. *Necrobia rufipes* B. *Dermestes maculatus* C. *Saprinus planiusculus*)