



## Generating pioneer data on Entomo-fauna of forensic importance in Udaipur region of South Rajasthan

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### Abstract

Forensic Entomology is the emerging branch of science that includes the study of succession pattern of insects on crime scene such as to observe the stages of life cycles of insects from decomposed bodies for calculating PMI (Post Mortem Interval) and many medico-legal activities. Entomo-Fauna of forensic importance are very suitable for detecting the criminal activities like estimating the time of crime, location of crime and nature of crime. The study of associated entomo-fauna from a crime scene has now become a pre requisite for crime detection in any geographical area. Many insects have important role in forensic entomology like Dipteran flies from Sarcophagidae and Calliphoridae in early stages of carcasses. There has been no survey conducted and compiled on the presence of entomo-fauna arriving on carcasses at this geographically very important zone of South Rajasthan. The purpose of this study is to collect, identify and document the pioneer data of useful forensic insects and their applicability in forensic detection of crime scene. It will certainly give a new way for the forensic scientist engaged in crime detection. Although this is a limited scale study it was found that Calliphoridae and Sarcophagidae dominated the data collection followed by Coleopterans and Hymenopteran species.

**Keywords:** PMI (post mortem interval), sarcophagidae, calliphoridae, medico-legal

### 1. Introduction

Forensic Entomology is emerging branch of science there insects associated with a human corpse in an effort to determine elapsed time since death or Post mortem interval (PMI) [1]. And new emerging field of science that's provide the information of insects of forensic importance, and major objective of forensic entomology is solve the criminal aspects like detect the time of crime, location and nature of crime with the help of arthropods [2]. Forensic entomology was initially observed from china in 13<sup>th</sup> century. Several types of insects are beneficial for forensic investigations. Order Diptera and Coleoptera have major forensic important species like Sarcophagidae and Calliphoridae are most frequent flies found in early stage of death and Silphidae and Dermestidae beetles are found in Decomposition stage of body. At globally forensic entomology primarily used to estimate the post-mortem interval (PMI) Determining time of death is extremely important in a death investigation as it focuses the investigation into the correct time frame. Most forensic Entomological studies have provided information on PMI studies, and all aspects about drugs related deaths. However, after some time of crime, insect evidence is often the most accurate method of determining elapsed time since death.

Medico-legal entomology one of the field of forensic entomology is a tool that is commonly used to estimate the time interval between death and the discovery of the corpse, known as the Post-mortem Interval. Another application is to recognizing weather body has been moved from crime scene to elsewhere. Forensic entomologists use insects and other arthropods to solve the legal issues [3]. Several reasons

for using insects in crime detection because insects are usually the pioneer who find a decomposing corpse and the arthropod fauna on a corpse changes in a successional sequence as modifications of the cadaver occur (decomposition stages). And not only calculate the PMI but also detect the crime location like if the dead body after crime was moved from crime palace to different location then it can also solved by forensic insects because some forensic insects is found in particular area so crime can be easily solved with forensic entomology. Different stages of life cycle of flies give a dynamic role in crime detection (egg, larval, pupa, and adult). The toxicological and molecular examinations of these forensic important insects also may helpful in determine the cause of death or even the nature of a victim.

The main objective of this research is to study insects of forensic importance and succession pattern, stages of decomposition on carrion and to generate pioneer data base information for further medico - legal activities.

### 2. Materials and Methods

The study was carried out in Laboratory of public health entomology in University college of Science Udaipur. The study was done in two different times in October month of 2019 and February month of 2020 at different locations for observe the forensic important species on carcasses. Experiment was done on goat liver and dead Wild rat and laboratory reared mice (mus - musculus) kept in cages at different locations To study the insect succession pattern and stages of decomposition, observed the all activities of insect succession from egg laying to adult stages on carrion

and regularly observe the environmental conditions like temperature and humidity in study area.

For completing the work used the standard protocol and following tools -Entomology kit, Insects net, Collecting vials, larval forceps, Wide mouth bottles, Plastic containers and plastics specimen cups, Thermometer for measuring temperature, Chamber, Camera, Preserving solution, Disposable gloves, Dropper and pipettes, Shipping containers, Vermiculite, Ruler/tape, Log book.

The goat liver and mice were kept in plastic cages with make small – small holes for entry of insects along with moist cotton and hang in university campus. For observing the pioneer insects after 4 hours of sample put check the activities of initial entomo - fauna and later stage of decomposition. And sampling was done with insect collecting aerial net and killed with chloroform and pinned for identification and further study.

### 2.1 Sampling

For observe the insect fauna Sampling of flying insects (Diptera) were captured by sweeping hand net over the Goat and mice carrion and then the collected flies were transferred into the killing jar having ethyl acetate. Beetles collection were done with the help of forceps (Reed, 1958) [2]. The collected insects were transferred in vials having 70% ethanol and also labelled with the location, date, time and temperature. All the vials were brought in to the laboratory for further identification of insects; collected insects were observed under Stereo zoom microscope (Model No. RI-90-01) and identified by running the keys for Muscidae [4], Calliphoridae [4], Sarcophagidae [5] and Coleoptera [6], with the help of their morphological characters. And ambient temperature and humidity measured with the help of thermo hygrometer (288-CTH).

### 2.2 Rearing of Immature Stages

Laboratory rearing of these forensic insects done with standard protocol. Larvae were collected from the carrion and brought into the laboratory. Larvae were transferred in the rearing cage with piece of goat meat for feeding, developmental stages were observed till emergence of adults. Flies were identified by morphological identification key.

### 3. Result and Discussion

The present study conclude that family Sarcophagidae and Calliphoridae and Dermistidae, Silphidae have most dominant insects of forensic importance in Udaipur region of southern Rajasthan such as *c.megacephala*, *c.albicpies*, *c.vicina*, *S.rufficornis*, *M.domestica*. Sarcophagidae are first colonizer in few hours of death but in low abundance and flesh flies direct deposit first instar larvae (maggots) instead eggs, while Calliphoridae are not found in within the death but highly abundant species and deposit egg on carcasses and initiate succession. During work four stages of decomposition were observed, these are fresh, bloated, decay and dry decay and different stages have different entomofauna. Various type of environmental factors influence the succession patterns of insects like as, geographic location, habitat, season, temperature, humidity, insect abundance and carrion accessibility.

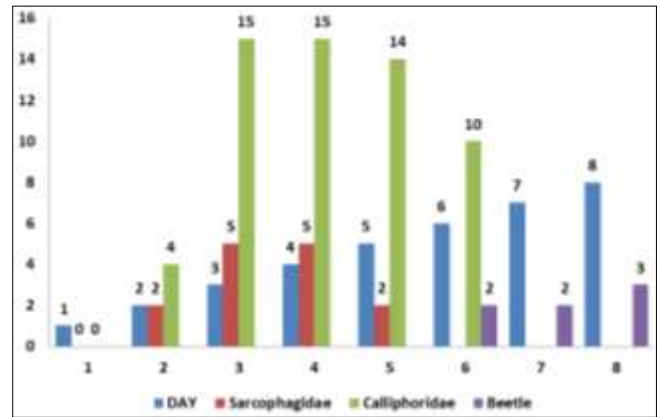


Fig 1: [Occurrence of Forensic Insects on Carcasses]

The present study provide the information about that Sarcophagidae and Calliphoridae flies use the cadavers as a food source and habitat so after few time of death these flies aggregate on dead bodies and start the life cycle from egg laying to adult. Calliphoridae and Sarcophagidae are most common invaders of forensic importance in Udaipur region of southern Rajasthan. Estimate the PMI have two methods – firstly during the early stages of decomposition, the estimate is based on the growth of life cycle of blow and flesh flies observed at the death scene. Because these both flies are attract on dead bodies within few hours of death. And secondly determine the pattern of insects in the later stages of decomposition. Within the time egg emerge in larval stages ( maggots )and these maggots are part of a tool for detect the PMI, If we have an idea about life cycle of these forensic flies and length of maggots then easily calculate the PMI.

Lord (1983) suggested a protocol for the collection and preservation of arthropod specimens from a corpse and the immediate vicinity. The body and the decomposers are important sources that provide the information about crime [7]. It has long been observed that insects associated with vertebrate carrion display PMI dependent process (Hall-2007). Post Mortem changes in a body depend upon many factors and PMI can be a difficult factor to determine [8]. Introna *et al.* (1991) observed that different species were active during summer seasons. *Calliphora*, *Livida*, *Calliphora viora* and *Cucila illustria* were observed only during springtime while *Phaenikia sericata* and *Sarcophaga sarracenioides* were observed only during summer seasons. They also calculated the developmental time the species encountered during and summer season [9]. Anderson (1996) observed *Calliphora vomitoria* to determine time of decapitation [10]. Gurner *et al.* (2007) conclude the relative abundance and seasonality of forensically important blow flies in rural North Central Florida using pig carcasses as models for human bodies [11]. Jeffery (2007) studied the application of DNA based methods in Forensic Entomology and observed the identification of insects by molecular level [12]. Heo *et al.* (2007) identify the species that are unique to certain habitats allows dipterans to be used as a geographical indicator, which is useful in cases were the body has been moved (13). Mulieri *et al.* (2008) analysed the temporal changes of (Diptera: - Sarcophagidae) abundance simultaneously at

Monthly intervals during a year in a woodland and in grassland in a nature reserve to Buenos Aires, Argentina. During the sampled year, they collected 1305 flesh flies from 18 different species<sup>[14]</sup>. Segura *et al.* (2009) observed the succession pattern of cadaverous of forensic important in Colombia<sup>[15]</sup>. Abdul – Rassoul *et al.* (2009) collected adult Dipterous flies monthly from exposed animal carcasses in Baghdad city. Their results showed that flies could be collected all over the year but with narration their population density in different seasons<sup>[16]</sup>. Bharti (2009) draw the Life tables for two forensically important flies' *caliphora vicina* and *musca domestica nebulosa* at varying temperatures. These findings would be helpful in legal investigations<sup>[17]</sup>. Senta Niederegger (2011) observed the forensic flies' growth rate for estimation of PMI. Interspecific morphological similarities, however, complicate species determination. And also observe the Muscle attachment site (MAS) patterns for identification of forensically important flies<sup>[18]</sup>.

Goyal (2012) studied to determine the time since death in cases of decomposed bodies and observed the calculated the Post Mortem Interval (PMI)<sup>[19]</sup>. Singh (2012) in Punjab and Rajasthan examined the ultra-morphological characteristics of immature stages of a flesh flies *Para Sarcophaga* (Fabricius) (Diptera:-Sarcophagidae)<sup>[20]</sup>. Verma (2013) recorded the study of *Chyrosoma rufifacies* from India for forensic importance<sup>[21]</sup>. Jyoti *et al.* 2019 studied the incidence and succession of forensically important insects associated with goat fish and observed the 125 species of Sarcophagidae, Calliphoridae, Muscidae from Himachal Pradesh<sup>[22]</sup>. Gemmellare (2019) observe the molecular identification techniques for forensically important insects<sup>[23]</sup>. Bhaskaran *et al.* (2019) observed the forensically important insects and their biology on fish and evaluate the attraction preference toward the postharvest stage of fish<sup>[24]</sup>.

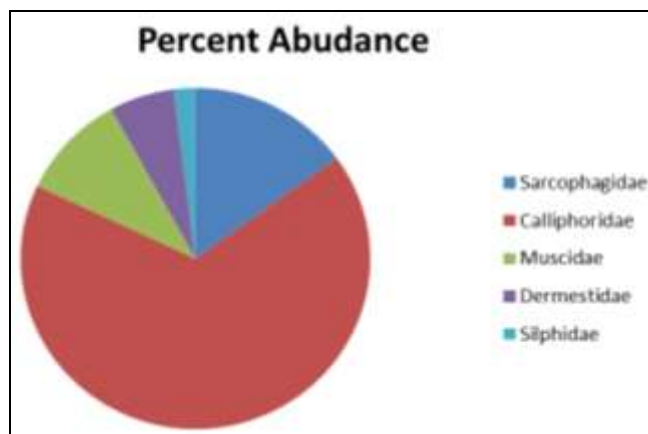


Fig 2

#### 4. Conclusion

The present work indicate that Dipterans flies like flesh flies (Sarcophagidae), green and blue bottle flies (Calliphoridae) are dominant flies in Udaipur region of southern Rajasthan, for medico-legal activities in early stage of crime. And Coleopterans (beetles) Dermestidae and Silphidae were found in decomposition stage. These are more accurate for forensic purpose, and these flies are attracting on carcasses in early stages of decomposition. These flies are visit surrounding on dead animals within 24 hours and deposit eggs on carcasses and start life cycle, succession pattern (egg/maggots to adult) of these flies are accurate method to

estimate PMI in medico-criminal investigations. And study of these forensic insects will be pioneer data for further forensic purpose.

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