



An Analysis of the Ecological Succession Pattern of Diptera on the Carcass of Laboratory Bred Rats

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Abstract – Jaipur has a hot semi-arid steppe climate. Environmental conditions have a direct impact on the fauna of forensically important flies. So an effort was made to study and identify the fauna of flies of forensic significance. Flies were collected twice a day using insect nets from 2nd Nov. 2015 to 7th Nov. 2015. Laboratory bred rats, *Rattus norvegicus* Wistar, were used as bait for the flies. The captured flies were identified using taxonomic keys. During present study, a total number of 9 species of flies in four families, viz. Calliphoridae, Sarcophagidae, Muscidae and Phoridae were collected. *Parasarcophaga (Liopygia) ruficornis* (Sarcophagidae) was pioneer species to visit the carrion, followed by Calliphoridae, Muscidae and Phoridae. Phorid flies were observed to arrive at the carcass on the third day. However, the most abundant flies were of Calliphoridae (44.24%), followed by Muscidae (28.87%), Sarcophagidae (16.53%) and Phoridae (13.35%).

Keywords – Forensically Important, Calliphoridae, Muscidae, Sarcophagidae, Phoridae, Semi-arid.

I. INTRODUCTION

Forensic entomology is the application of the study of arthropod to legal issues. Its most important application is the estimation of Post-mortem interval (PMI) [1]. The successional pattern of arrival of necrophagous insects at a cadaver is a key feature in the estimation of the minimum post-mortem interval. The type and composition of taxa that are attracted to a carcass usually change in a predictable pattern as decomposition progresses through the different stages [2]-[4]. Insect colonization and period of colonization depend on many factors such as environmental conditions and conditions of the corpse (position, sunshine or shade, clothes, indoor or outdoor) [5]. Therefore, the pattern of succession of insects is specific to the location and environmental conditions in which a carcass occurs [6].

Because taxa can vary greatly with locale, the identification of the forensically important insects that are specific to an area is important for precise estimation of the PMI [7]. Hence, for use of insects in legal medicine, sufficient data should be collected in each geographical region, such as time of arrival of insects to the corpse, insect succession on cadavers and biology of insects [1].

Studies of carcass arthropods and their successional pattern on carcass have been comprehensively carried out in many regions of the world [8]. Studies on insects associated to carrion are well documented in different regions of India as well. However, such studies have not been documented so far in Rajasthan. So the objective of

the present study is to determine insect fauna associated with carrion in Jaipur region of Rajasthan.

II. MATERIAL & METHODS

To study the successional pattern of Diptera on the carcass, laboratory bred rats, *Rattus norvegicus* Wistar weighing ~200 g, were used as experimental animal model, in the campus of University of Rajasthan, Jaipur. The study was conducted for 6 days. Physical environmental conditions, like temperature and humidity were recorded daily. The average of maximum and minimum temperature and relative humidity was recorded as 32.38°C, 19.5°C and 52% respectively.

The rats were placed in wooden cages in the campus (bushy area) (Fig.1). The cages had wider mesh to allow entrance of the insects. The experiment was carried out in five replicates. Observations and collection of flies were made thrice daily for six days (2.11.2015- 07.11.2015). Adult flies were collected using insect nets, which were killed using ethyl acetate and then pinned with entomological pins for further studies. Identification of the species was accomplished using taxonomic keys of [2], [9]-[12].

III. RESULTS

The present study revealed seven genera and eight species from four families of Diptera associated with the carcasses during the study (Fig.4). Decomposition of the rats lasted for six days, from 2nd November to 7th November, 2015. During this period, flies from four families, viz., Calliphoridae, Sarcophagidae, Muscidae and Phoridae, were collected. Sarcophagidae was the first one to visit the carrion followed by Calliphoridae (Fig.3). *Parasarcophaga ruficornis* visited the carrion after 13 minutes of exposure of the carrion (Fig.2). The most abundant family was found to be Calliphoridae followed by Muscidae, Sarcophagidae and Phoridae (Table I & Fig. 5). *Musca domestica* and *Chrysomya megacephala* were present throughout the study, whereas *Megaselia sp.* Belonging to Phoridae arrived at the carcass on third day (Table II).

IV. DISCUSSION

In the present study, Sarcophagidae family was observed as the first fly species that visited the carcass, however, its abundance was less than *C. megacephala* and *M. domestica*. This is in agreement with the studies which

suggest that flesh flies are primary invaders of carrion in warm temperature and tropical region, whereas secondary species in cooler regions [2], [13], [14]. However, results are contradictory to the results given by [15] who studied forensically important diptera associated with dog carcass in Pakistan and observed *C. rufifacies* as the first colonizer on the carcass followed by *P. ruficornis*. Other important flies in their study were *M. domestica* and *Piophilidae casei*. Unlike the results of the present study, [16] observed order of succession of Dipteran flies on decomposing dog (*Canis lupus familiaris* L.) carcass at Ankara province as Calliphoridae, followed by Sarcophagidae and Muscidae. They observed *C. albiceps*, *C. vomitoria* and *C. vicina* from Calliphoridae family; *Sarcophaga sp.* from Sarcophagidae family and *Musca sp.* and *Hydrotaea ignava* from Muscidae family. Similarly, [17] also reported that adults of Calliphoridae were amongst the initial colonizers of the corpse, arriving shortly after exposure of the carrion and laying eggs into the natural orifices. Ref. [18], [19] also reported *C. nigripes* and *C. megacephala* to visit the carcass first in their respective studies. Likewise, [20] in Bhagdad collected five families of Diptera from the carcass and also reported Calliphoridae and Muscidae as the initial colonizers of the carcass.

In the present study, although *P. ruficornis* was the initial colonizer but *C. megacephala* and *M. domestica* were dominant species which is in accordance with [21] who also reported *M. domestica* as the most prominent diptera in their study. However, [22], [23] revealed in their study that *C. megacephala* and *C. rufifacies* were dominant species in forests area. Similarly, *M. domestica* and *C. rufifacies* were reported to be present in the fresh, bloat and active decay studies in Pakistan by [24].

Among families, Calliphoridae predominated in the carrion during the present study of fresh, bloat and active decay stages of decomposition. This is in consonance with the study of [25] who identified 229 individuals belonging to 11 species from six families of Diptera from two mangrove areas of Peninsular Malaysia and recorded *C. megacephala*, *C. rufifacies* and *Hydrotaea sp.* as the most abundant species in their study. However, [26] registered Phoridae, Anthomiidae and Fanniidae as important forensic families besides Calliphoridae and Sarcophagidae. The dominant species among colonizers, in their study, were *Hemilucilia segmentaria* Fabricus (Diptera: Calliphoridae), *H. semidiaphana* (Rondani) and *Ophyra chalogaster* (Wiedmann) (Muscidae). They observed *Megaselia scalaris* Loew (Phoridae) was the most abundant species at the period immediately after death. On the contrary, in the present study, *Megaselia sp.* was seen on the third day of experimentation.

V. CONCLUSION

The present study concludes that dipteran species of the families Calliphoridae and Sarcophagidae are able to reach cadavers within a few hours of death and are the first colonizers of a corpse which is in accordance with [6], [8], [27], [28]. Similarly, [29] have also concluded in their

study that potentially important diptera are *C. albiceps*, *C. megacephala*, *C. putoria*, *Phaenicia eximia* and *H. segmentaria*, *Pattonella intermutans*, *Liopygia ruficornis* and *Adiscochaeta ingens*. These were able to breed in carrion exposed to natural environmental conditions. This ability has led to the more frequent use of sarcophagids and calliphorids as evidence in medico-criminal investigations [3].

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Fig. 1. Cage designed to protect the rat carcasses from scavengers



Fig. 2. Sarcophagidae (encircled) as initial colonizer in carcass of laboratory bred rat



Fig. 3. Calliphoridae (arrow) as second in the order of succession in carcass of laboratory bred rats



Fig. 4. Dipteran flies on the third day of decomposition of rat

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Table I : Identified dipteran species and their absolute and relative abundance

Family	Generic name	Common name	Absolute abundance (n)	Relative abundance (%)
Calliphoridae	<i>Calliphora vicina</i> Robineau Desvoidy,1830	Urban Blue bottle fly	12.2	10.1836%
	<i>Lucilia sericata</i> (Meigen,1826)	English sheep blow fly/ Green bottle fly	10.2	8.5141%
	<i>Chrysomya albiceps</i> (Wiedemann,1819)	Hairy maggot blue fly	9.8	8.1803%
	<i>Chrysomya megacephala</i>	Oriental latrine fly	20.8	17.362%
Sarcophagidae	<i>Parasarcophaga (Liopygia) ruficornis</i> (Fabricius,1794)	Flesh fly	13.8	11.519%
	<i>Sarcophaga sp.</i>		6	5.001%
Muscidae	<i>Musca domestica</i>	House fly	25.2	21.035%
	<i>Ophyra sp.</i>		5.8	4.841%
Phoridae	<i>Megaselia sp.</i>	Hump-backed fly	16	13.355%

Table II: Successional patterns of dipteran flies associated with decomposing rat carcasses at different time intervals after death

Family	Species	3 hr	24 hr	48 hr	72 hr	96 h	120 hr	144 hr
Calliphoridae	<i>Calliphora vicina</i>	*	*	*	*	*	*	*
	<i>Lucilia sericata</i>	*	*	*	*	*	*	*
	<i>Chrysomya albiceps</i>			*	*	*	*	*
	<i>Chrysomya megacephala</i>	*	*	*	*	*	*	*
Sarcophagidae	<i>Parasarcophaga (Liopygia) ruficornis</i>	*	*	*	*	*	*	*
	<i>Sarcophaga sp.</i>		*	*	*	*	*	*
Muscidae	<i>Musca domestica</i>	*	*	*	*	*	*	*
	<i>Ophyrasp</i>			*	*	*	*	*
Phoridae	<i>Megaselia sp.</i>				*	*	*	*

Fig. 5. Relative abundance (%) of forensically important Dipteran flies in Jaipur region

