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Seasonal Variations in Life Cycle Of Forensically Important Calliphoridae Fly *Lucilia Cuprina* In Nandurbar (MS) India

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ABSTRACT

Forensic entomology is one of the important branch of the forensic science. It is developed over the years. It was useful for the finding post mortem interval (PMI) with the help of season of death, geographical location of death, movement or storage of remains after death etc. Insects are greatly provides valuable information from their life cycle and there developmental stages. The age of the most developed blow fly larvae (Calliphoridae) can indicate a minimum post-mortem interval (PMI) since blow flies are usually the first colonizers on remains. To calculate the age of blow fly larvae develop on a corpse, their development has to be determined as correctly as possible. This is important for solving crime. Proposed work done on the Calliphoridae fly, *Lucilia cuprina* which is common in Nandurbar district of Maharashtra state in India. The objective of this research work was to prepare preliminary database of fly present in this geographic area and environmental conditions.

Key words: Forensic entomology, PMI, Calliphoridae, *Lucilia cuprina*, Nandurbar.

INTRODUCTION

Forensic entomology as a science and most important ecological tool used for crime investigation. The analysis of insect evidence for forensic and legal purposes used within judicial systems throughout the world. A body after death is occasionally subject to destruction by different types of animals amongst which insects can have a major role in the breakdown of the cadaver. There are two primary ways to estimate the postmortem interval (PMI) of human remains using entomological evidence. Insect successions of arthropod species found on a body provide one method of determining the PMI (Schoenly and Reid, 1987). Insects arrive at decomposing remains in predictable, successive waves based on the stage of decomposition (Reed 1958; Payne, 1965). The other method utilizes the degree of development of the oldest maggots feeding on the corpse, from which one can determine a close approximation of the time since death. Insects often lay eggs within minutes or hours after death (Catts and Goff, 1992), thus providing a developmental reference. Although the amount of research increased in the field, but there was no great popularity of this branch of forensic science in India. Information gained from forensic entomology typically is used to determine time of death, place of death and other issues of medical or legal importance (Gordh and Headrick, 2001).

Flies have been recognised as providing significant entomological evidence in the medico-legal field. The principal methodology used in medico-criminal entomology is application of the temperature dependent development of insects, especially flies, for estimating a decedent's PMI (Hall, 2001). Work conducted on the life cycle of the Calliphoridae and Sarcophagidae, the two families most likely be found on a decomposing corpse was used to figure out the time of death.

Identifying an insect specimen is an important step in a forensic entomological analysis. Several experimental studies using animal models has been investigated the intrusion of the insect community in the cadavers decomposition process. Thus, to understand the knowledge of course of cadaver breakdown and factors inhibiting or favouring colonization and development is necessary for estimating the PMI in any death by using entomological data. Therefore, the objective of the present research work was to determine the potential use of insects that are of importance in estimating the time of death for the study area.

MATERIAL METHODS

Collect the accidental dead body of dog and place to it safe in open field. After some minutes flies arise on body, they laid eggs on them. The developing stages were collected on each day (hrs). The regular observations were done and were recorded. The stages were photographed and weighed on the electronic balance. Measurements of these stages were made by means of the microscope whose least count is 0.001. At the same time the temperature and humidity (maximum, minimum and at the time of observation and collection) were recorded. Measurements of five maggots were done at each time and their average and the standard deviation was recorded in the tables. The work was carried out in three seasons, rainy, winter and summer to find out the variations in the duration of life cycle and other data with respect to the temperature. The data obtained is tabulated in the tables for different seasons. The maggots before pupation find the concealing places and usually borrow in the soil.

RESULTS & DISCUSSION

The life cycle of *Lucilia cuprina* flies in summer, winter and rainy season was completed in 226, 251 and 298 hours respectively. The details of length, width and weight variations are given in Table A, Table B and Table C in summer, winter and rainy season respectively. The details of the temperature and relative humidity variations during the development in summer, winter and rainy season are given in table D, E and F respectively.

There is no work in Nandurbar region on forensic entomology. This is the first report and attempt of insect succession on carrion carried out in the studied area. In present work we studied the seasonal variation in the life cycle of fly, *Lucilia cuprina* as it is important to study in forensic entomology. The data were collected in three different seasons i.e. summer, winter and rainy during the study period (2008 to 2009) and also mentioned some database on morphometric and environmental conditions like temperature and humidity.

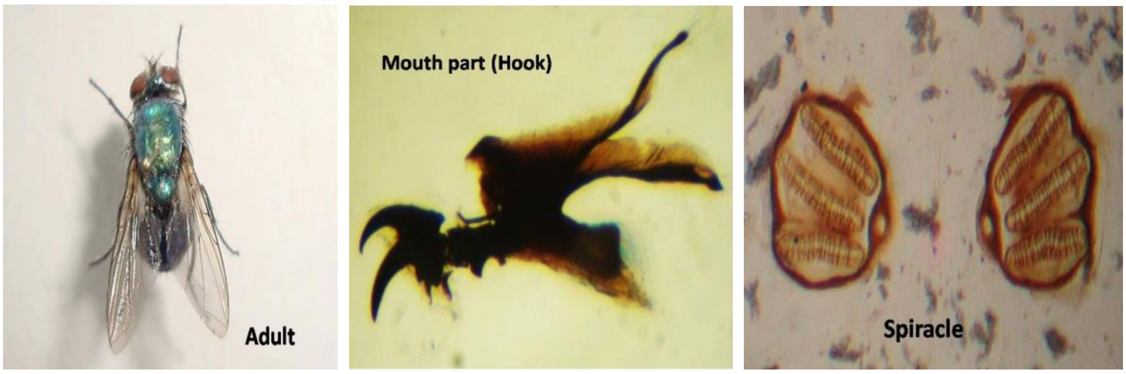

Figure 1. Shows the adult fly *Lucilia cuprina,* mouth part and posterior spiracle of larvae.

Table 1: Morphological parameters of the developing stages of *Lucilia cuprina* in summer season

Period since egg laying in Hours	**Duration in hours**	**Development (stages)**	**Avg.length (mm)**	**Avg.width (mm)**	**Avg.weight (mg)**
00-18±16min.	18	Eggs	1.8±0.002	0.4±0.004	0.49±0.00
18-39±26min	21	1st Instar	4.2±0.017	1±0.009	3±0.024
39 -64±29min	25	2nd Instar	8.8±0.029	1.9±0.03	21±0.54
64 -98±36min	34	3rd Instar	12.7±0.081	3±0.31	49±1.19
98 -127±1.22hrs	29	Prepupa	10.7±0.14	3±0.039	41±1.68
127-141±5.21hrs	99	Pupa	7±0.12	3±0.028	35±1.73

(±) shows standard deviation of five values

Table 2: Morphological parameters of the developing stages of *Lucilia cuprina* in winter season

Period since egg laying in Hours	**Duration in hours**	**Development (stages)**	**Avg. length (mm)**	**Avg. width (mm)**	**Avg. weight (mg)**
00 - 20 ± 19 min.	20	Eggs	1.8±0.04	0.4±0.006	0.48±0.002
20 - 42 ± 29 min.	22	1st Instar	4.5±0.16	1±0.003	3±0.073
42 - 65 ± 32 min.	23	2nd Instar	9±0.37	2±0.03	24±0.59
65 -104 ± 41 min.	39	3rd Instar	13±0.41	3±0.029	48±0.98
104-135±1.52hrs.	31	Prepupa	12.2±0.71	3±0.2	43 ±0.48
135-159±8.12hrs.	134	Pupa	7±0.51	3±0.14	35±1.09

(±) shows standard deviation of five values

Table 3: Morphological parameters of the developing stages of *Lucilia cuprina* in rainy Season

Period since egg laying in Hours	**Duration in hours**	**Development (stages)**	**Avg.length (mm)**	**Avg.width (mm)**	**Avg.weight (mg)**
00 - 21 ± 19 min.	21	Eggs	1.8±0.04	0.4±0.007	0.49±0.002
21 - 43 ± 31 min.	23	1st Instar	4±0.10	0.9±0.00	3 ± 0.03
43 - 70 ± 39 min.	27	2nd Instar	8.7±0.26	1.9±0.011	23 ± 0.59
70 -112 ± 47 min.	42	3rd Instar	12.5±0.34	3±0.09	48±1.44
112-36 ±2.23 hrs.	46	Prepupa	12±0.36	3±0.06	42±1.19
136 -182±8.2 hrs.	139	Pupa	7±0.69	3±0.07	36±1.68

(±) shows standard deviation of five values

Table: 4 : *Lucilia cuprina:* life cycle in summer season

Hours	**Developed stage**	**Temperature (oC)**			**Humidity (%)**		
		Recorded	**Max.**	**Min.**	**Recorded**	**Max.**	**Min.**
00 – 18	Eggs	34.5	37.6	28.5	30	38	19
18 – 39	1st Instar	32.8	38.3	28.8	27	35	18
39 – 64	2nd Instar	33.1	39.1	29.2	23	36	18
64 – 88	3rd Instar	34.7	40.2	29.5	22	35	19
88 – 98	3rd Instar	34.2	39.2	28.3	25	37	19
98 – 122	Prepupa	34.5	38.6	29.4	26	34	20
122 – 127	Prepupa	33.3	37.4	28.1	25	35	22
127 – 141	Pupa	33.9	37.7	28.5	24	32	21
141 – 165	Pupa	32.2	38.1	28.1	27	33	17
165 – 189	Pupa	34.9	37.4	28	26	31	19
189 – 213	Pupa	32.7	38.3	28.5	27	35	17
213 – 226	Adult	31.2	37.8	29.8	23	34	19

Table: 5: *Lucilia cuprina:* life cycle in winter season

Hours	Developed stage	Temperature (^0C)			Humidity (%)		
		Recorded	**Max.**	**Min.**	**Recorded**	**Max.**	**Min.**
00 – 20	Eggs	29.9	33	23.5	55	64	49
20 – 42	1st Instar	30.8	33.4	22.8	57	65	48
42 – 65	2nd Instar	30.1	32.1	23.2	53	66	50
65 – 89	3rd Instar	30.7	32.8	24.5	52	65	43
89 – 104	3rd Instar	29.9	32.4	22.7	54	68	46
104 – 128	Prepupa	30.2	33.1	21.8	51	71	47
128 – 135	Prepupa	29.6	32.9	22.6	56	68	45
135 – 159	Pupa	30.1	32.8	23.5	57	67	47
159 – 183	Pupa	29.7	31.9	21.3	53	69	49
183 – 207	Pupa	30.3	32.8	24.5	52	66	45
207 – 231	Pupa	29.8	32.6	22.8	57	70	47
231 – 251	Adult	30.2	32.4	23.4	56	68	48

Table: 6: *Lucilia cuprina*: life cycle in rainy season

Hours	Developed stage	Temperature (^0C)			Humidity (%)		
		Recorded	**Max.**	**Min.**	**Recorded**	**Max.**	**Min.**
00 - 21	Eggs	28.5	29	23.5	65	88	59
21 – 43	1st Instar	27.8	29.6	22.8	67	82	58
43 – 70	2nd Instar	28.1	28.1	21.2	63	76	57
70 – 99	3rd Instar	29.7	30.2	21.5	70	77	61
99 – 112	3rd Instar	28.8	29.9	23.4	71	76	59
112 – 136	Prepupa	29.3	29.8	22.7	69	78	56
136 – 158	Prepupa	28.6	30.1	21.8	71	80	57
158 – 182	Pupa	29.9	30.2	22.6	66	81	65
182 – 206	Pupa	29.7	30.6	23.5	67	76	57
206 – 230	Pupa	29.2	30.2	21.3	68	75	59
230 – 254	Pupa	29.7	30.8	23.5	72	81	65
254 – 278	Pupa	29.8	30.6	22.8	67	78	57
78 – 298	Adult	29.3	30.4	20.4	66	72	58

In general climatic conditions, mostly temperatures, play an important role in the insect activity and carrion decomposition. Variations in climatic conditions lead to differences in the decomposition speed, insect development rate and succession pattern in different habitats, seasons and geographic locations (Anderson, 2009). Insect development has been studied under various temperatures to determine development rates, thresholds, and effect on mortality.

The effect of temperature on the development of *C. macellaria* (Byrd and Butler, 1996) and on *C. rufifacies* (Byrd and Butler, 1997) was studied under various temperature regimes. Development curves for the eggs, larvae, and pupae were developed under both cyclic and constant temperatures. Anderson (2000) obtained minimum and maximum development rates of five forensically important Calliphoridae species at several temperatures, including *Phormia regina*, *Lucilia sericata*, *Calliphora vicina*, *Eucalliphora latifrons*, and *Lucilia illustris*.

The rates of insect development and their pattern of succession on the carrion differ from country to country and even from area to area within the same country, mainly because of the variation in the topography and climate or weather. Thus, it is not possible to use the data available in one country and apply it to the crime entomology in another country.

In recent years, several mathematical models have been developed based upon observations on development times for stages and instars in experimental conditions and interpolating these data against on-site conditions to estimate PMI (Zuben, 1998).

Some forensic entomologists use the maggot's weight to pin point its age. Using the spiracles and length is the most effective way to determine age of a maggot, but in some cases the maggots are not preserved correctly and the exact length cannot be recorded and the spiracles can be difficult to identify. Most techniques used today by uninformed individuals to preserve maggots can lead to shrinkage and deformation. The most appropriate way to preserve these specimens is to fix their internal protein by placing them in boiling water for approximately 10 seconds (Tantawi and Greenberg, 1993). To use the weight of the maggot for age determination, a statistical model relating distributions of weights to age must be formulated and fit to the data.

Conflicts of interest: The authors stated that no conflicts of interest.

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