

Transmogrification of Entomological Inhabitants and Results in Death Scene Area Of *Musca Domestica* and *Chrysomya Megacephala*

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Abstract

The application of facts of entomological inhabitants in the course of investigation of crimes precisely utilising insects is known as forensic entomology. This also helps in deciphering the cases regarding time since death. *Musca domestica* (house fly) and *Chrysomya megacephala* (blow fly) are two such insects which are immensely beneficial in cracking mysterious demise cases. In this study an imperative effort has been made to assess the post mortem interval of the putrefied bodies by utilising entomological inhabitant proof. The significant aspects and statistical figures linked to climate, weather, temperature and geography of the site is gathered. Post mortem examinations are established to accomplish the cause, manner and mode of death. Entomological proof in the form of *Musca domestica* and *Chrysomya megacephala* in their various phases of growth is witnessed on putrefied corpses. The larvae reveals speedy motility behavior which specifies that there is intense tussle among inter or intra specific larvae on corpses. Large insects such as wasps and beetles which feed on flies (incidentals) were witnessed on the corpse in the eventual stages of putrefaction which help in determining time since death. The progressive phases of *Musca domestica* and *Chrysomya megacephala* was precisely witnessed in this study.

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Introduction

Musca domestica is a popular broad-based pest present in homes and farms. This is a species which is constantly related with

humans, it is found in filthy areas consuming the dead and decomposed matter. *Musca domestica* mainly feed on liquid food but they also utilise solid food by

changing them into liquid through spitting or puking on it and dissolving it in the salivary glands secretion. They devour any moist or decomposing matter but are specifically attracted to the pet waste due to their robust odour. Its requirement for food is twice or thrice a day (Keiding J 1986). These flies are an irritation which transports sickness causing organisms. These flies acts as transporters of disease causing agents like bacteria (*Eseherichia coli*, *Salmonella*, *Shigella*) which spread umpteen number of diseases in mammals like rickettsial, dysentery and helminthic infection. In a death scene area *Musca domestica* plays a pivotal role as a forager, this insect grows in different substrates such as bovine dung, horse dung, swine poop, bird droppings, sheep and goat dung and human excreta, it also grows on decaying vegetable matter, carrion and kitchen swill (Cook *etal.*, 1999). *Musca domestica* initiates its life cycle and concludes on the corpse, cadaver and carrion. The age of the maggots and the growth of them is utilised in the first couple of weeks after death and it is precise to a couple of days or less (Amendt J, Krettek R, Zehner R, *Naturwissenschaften* 2004). Initially eggs are laid in batches and hatch after a period of time in to first instar larvae. The larva consumes the corpse and moults

into second and third instar larva. The dimension and number of breathing holes (spiracles) establish the phase of maggots (D.W. Richards & R. GDavis 1977). When the maggot attains third instar, the larva ceases to feed and deserts the corpse to find a safe dwelling to pupate and this is called the prepupal phase. The skin of the larva rigidifies into an exterior shell to safeguard it, as it transmogrifies into an adult. The freshly moulded pupae are pale in colour and gradually turns into deep brown in a couple of hours. After a number of days the adult flies emerges, leaving an empty pupal case behind as proof. *Chrysomya megacephala* is deliberated as a significant fly in forensic science because it is one of the initial flies to arrive on a corpse and so the time of death is easily determined when this flie's larvae are present on the body. The procreation and continued existence rate of this fly are closely allied to growth aspects, as well as the amount of accessible food. This fly has a comparatively long life span, as an adult which helps this species grow into more successful at invading new terrestrial areas. The long life span means that the parents are present to rear the offsprings ensuring their existence. The same metamorphosis as such in *Musca domestica* takes place

with *Chrysomya megacephala* and it also leaves behind a trail of evidence which aids in cracking a crime in a death scene area. “Every egg, every maggot, every pupae aids a forensic entomologist to ascertain the time since death in a death scene locality”.

Prerequisite of the study

The pertinent fact of this study is estimation of time since death utilising entomological inhabitants. Cracking crimes in death scene area using insect progression to establish time since death, the post mortem interval is utilised in the court of law to uncover mysterious cases which are on the verge of closure. The potential forensic value of entomological inhabitants is taken as an advantage, evidence is scientifically gathered and processed. Forensic entomology has now been an imperative part of probing of death, when estimating the time since death beyond 72 hours, forensic entomology is profusely considered as a precise method for estimating the elapsed time since death. The procedure of putrefaction is affected by environmental and evolutionary procedure. **Insects are enticed to and devour the leftovers in an anticipated form which is utilised to assess the age of the leftovers.** Environmental condition can effect forensically significant characteristics to

progress, contributing to errors in forensic predictions. Hence profuse requirements in accomplishing time since death are the juvenile progressive phases of entomological inhabitants.

Methodology

The procedure of this study encompasses the detailed facts and circumstantial evidence of the victim from the legal enquiry into the matter of facts and from the relatives and other persons accompanying the corpse. The other imperative statistical figures connected to climate, weather, temperature and geography of the site is gathered. Post mortem examinations are established to accomplish the cause, manner and mode of death. The time since death is assessed from the other findings. The insect evidence gathered is studied to assess and determine the time since death. The complete statistical figures and findings are documented in the proforma and the data gathered is analyzed to accomplish the goals and objectives of the current study. The paraphernalia for the current study comprises an entomological net where the insects are transferred to a killing jar containing “ether as toxic agent”. The gathered samples are taken to the laboratory and recognised based on the morphological features. Thirty six cases of

corpses had the proof of existences of insects or their juvenile phases on them. The study included the corpses taken from the morgue of department of forensic medicine and toxicology, government medical college Mysore for post mortem examination during the time of study.

The examination and gatherings of entomological proof have to be established under the guidance of a skilled forensic entomologists. The tacit procedure differs with the type of eco system, but usually the corpses are received in the mortuary and then examined followingly

- a) Keen observations and notation of the scene are made.
- b) The gathering of samples form the corpse before post mortem examination.
- c) Post mortem examination is

conducted to achieve the cause, manner and type of death.

- d) The insect proof has to be gathered and studied to determine the time since death.
- e) The complete statistical figure and discoveries are documented in the proforma and the data gathered is to be analysed to accomplish the goals and objectives of the current study.

Research questions:

1. What are the outcomes and stages of entomological inhabitants in death scene area?
2. What is the role of *Musca domestica* and *Chrysomya megacephala* on death scene area in three parts of ecosystem?

Table

Frequency per cent values of Stage of insect in death scene area and results of Cramer's V test.

SOD STG Insects Death Scene Area		Death Scene Area			Total
		Shelter	Field	Water	
Absent	Frequency	0	0	1	1
	Per cent	0.0%	0.0%	8.3%	2.8%
Egg	Frequency	3	2	2	7
	Per cent	50.0%	11.1%	16.7%	19.4%
Larva	Frequency	3	16	9	28
	Per cent	50.0%	88.9%	75.0%	77.8%
Total	Frequency	6	18	12	36
	Per cent	100.0%	100.0%	100.0%	100.0%

Test statistics: Cramer's V= .300; p=.167

When in SOD, the stage of insect in death scene area were analyzed in all the three phases (water, field, shelter), the above results was observed in all, out of thirty six cases, 28 dead bodies were examined larva was found, 7 cases had eggs, and remaining

1 case in water, no changes was observed. In a death scene area stage of insect were associated, a non- significant association was observed ($V = .300$; $p = .167$) revealing that stage of insect differs in all three phases.

Frequency per cent values on of *Musca domestica* Species in death scene area and results of Cramer's V test.

SOD Species MD Death Scene Area		Death Scene Area			Total
		Shelter	Field	Water	
No	Frequency	2	14	12	28
	Per cent	33.3%	77.8%	100.0%	77.8%
Yes	Frequency	4	4	0	8
	Per cent	66.7%	22.2%	0.0%	22.2%
Total	Frequency	6	18	12	36
	Per cent	100.0%	100.0%	100.0%	100.0%
Test statistics: Cramer's $V = .535$; $p = .006$					

In an SOD, *Musca domestica* species is witnessed at the crime scene area and results were analysed in different stages (shelter, field, water). The above results were noted, out of thirty six cases, in 28 cases there was no presence of this species in shelter, field and water, and in 8 cases the species existed

in shelter and field. When in death scene area *Musca domestica* species on the dead body were associated, a non- significant association was observed ($V = .535$; $p = .006$) through that insect species was differ from all three stages.

Frequency per cent values on of *Chrysomya megacephala* Species in death scene area and results of Cramer's V test.

SOD Species CMBF Death Scene Area		Death Scene Area			Total
		Shelter	Field	Water	
No	Frequency	4	1	5	10
	Per cent	66.7%	5.6%	41.7%	27.8%
Yes	Frequency	2	17	7	26
	Per cent	33.3%	94.4%	58.3%	72.2%
Total	Frequency	6	18	12	36
	Per cent	100.0%	100.0%	100.0%	100.0%

When in SOD, species *Chrysomya megacephala* at the crime scene area was analysed in different phases (shelter, field, water). The above results were noted, out of thirty six cases, 26 cases were inspected, species *Chrysomya megacephala* was found, and remaining 10 cases the species was not detected. In death scene area *Chrysomya megacephala* species were associated on the body, a non- significant association was perceived ($V=.530$; $p=.006$) revealing that the insect species vary from all the three phases.

Discussion

1. In a death scene area, stages of insect were associated, and a non- significant association was observed revealing the stages of insect. Majority of the larva was found in field.

2. When in death scene area, *Musca domestica* species was associated on the dead body, a non- significant association was observed, majority of the *Musca domestica* species was found in shelter and field.

3. In death scene area, *Chrysomya megacephala* species was associated on the body, and a non- significant association was observed and majority of *Chrysomya*

megacephala species was found in field.

Research question-1

In the first instance we witnessed entomological inhabitants in a death scene area, firstly we sighted maggots crawling and creeping on the corpse. In the alfresco, carcasses frequently invite flies such as *Calliphoridae*. The corpses receive more eggs than they can support to allow the maximum number of larvae to mature. For necrophagous insects, corpses are like ecological islands that have emerged from the ocean. Necrophagous insects are sheerly utilised as corroborating evidence in cadaver relocation (D. Charabidze- 2017) The larval stage of blow flies is the major period of nutrient ingestion during their entire life cycle, when they devour the largest amount of food before complete exhaustion, the larvae exhibits scrambling behavior which indicates that there is furious competition between inter or intra specific larvae on corpses (Mark Beneke- 2004). Eggs are tiny and usually laid in clusters these eggs are often found in wounds and natural orifices. The oviposited eggs hatch within twenty four hours and tiny crawling creatures called maggots start devouring the corpses or the

carcasses. The carrion arthropod coterie growth primarily as a continuum of gradual change, rapid at first, slow during peak activity and irregular in the last days as carcass resources become dwindled. Eggs are important when maggots or later insects stages are absent.

The stages of entomological inhabitants in a death scene area are as follows. As soon as death occurs the body starts decaying, approximately speaking the process of decomposition is isolated into a number of phases. The first phase i.e one to two days the corpse or the carcasses is seen in a fresh phase, after two to six days the corpse or the carcass is seen in an inflated phase, after seven to twelve days the corpse starts decaying, after thirteen to twenty three days it is termed as post decay phase, after twenty four days onwards it is called as dry stage, but these time periods differ among various sources. Many entomological inhabitants are attracted to the scene of the corpse, some are enticed by volatile compounds during putrefaction, the process involves two methods the first by direct effect they have on the fragmentation of proteins and carbohydrates, the second is by effecting the type of micro-organism in the soil (Statheropolous, M.,

Spiliopoulou, C., Agapiou et.al., 2005), and entomological inhabitants which converge on the body (Vass, A.A., Bass, W.M et.al., 1992). and some are drowned by the promise of other insects to feed upon. These insects colonise the remains at various points during the decomposition process to feed on the cadaver and procreate. (Hobischak et.al., 2006, Gail Anderson 2010). Other species may infest a death scene area not to devour the decaying body but to prey upon other insects at the scene.

After the eggs are hatched maggots appear on or near the remains and are in large masses, the masses generate heat and help in speedy development of maggots. (Charbidze D, Bourel B, Gosset D, 2011). These maggots voraciously devour and attain a stage where they are bound to form a pupa in a secluded place where they develop. The pupae are dark brown in colour and are oval in shape, they range in size from two to twenty millimeters, empty pupal cases look similar but at one end there exists an aperture where the adult flies emerge with a pair of crumpled wings.

In a death scene area, stages of insect were associated, and a non-significant association was observed in three phases. In a death scene area we took thirty six cases and

analysed in three phases of stages of insects i.e. shelter, field, and water. Out of thirty six cases we found three cases which had eggs in shelter and another three cases we found larva. There was multiple colonization of insects on a male cadaver discovered in the shelter of the municipality of Jaboatao dos Guararapes of Brazil, the corpse was inhabited by many species and the most copious species found were *Chrysomya albiceps* and *Chrysomoya megacephala*. They were respectively sixty 65.0% and 18.6%, in this case the capacity of insects to simultaneously accumulate on a corpse in sheltered environment and denotes the initial collaboration among the forensic police and Brazilian entomologists. Information on the growth of time of two species, *Chrysomya albiceps* and *Chrysomya megacephala* were utilised in the estimation of post mortem interval. (Vasconcelos SD, Soares TF, Costa DL-2013). Again out of thirty six cases with respect to field we found sixteen cases in which larvae were found and in two cases eggs were found, when a corpse is discovered in terrestrial region the soil is associated with cadaver decomposition, regardless of the species of mammal. The grave soil denotes a linkage among surface ground and interior ground ecology, the

relationship between grave soils, intrinsic cadaver putrefaction on the surface ground, the insect activity and scavenger activity is witnessed. As a consequence copious fundamental work is discovered on autolysis and putrefaction (Evans-1963; Coel-1973; Clark et al., 1997; Gill-king-1997; Vass et al., 2002). Again among thirty six cases with respect to water we found nine cases in which larva was present and in two cases eggs were found and in one case nothing was found and it construes that the body was completely submerged in water. Aquatic ecological studies substantiate that accumulation of insects on submerged corpses depends on many factors, such as size of the corpse, texture, position, flow of water, the temperature of water current speed, water depth, existence of aquatic flora and fauna. The remains of the corpse is an anchoring site, the fodder source and protection (Haskell et al., 1989). Accumulation of insects on the remains in water can be anticipated and this has been recorded many times on different inert materials (Tevesz -1985, Sheldon -1983) which has been utilised in forensic cases (Moran -1983). Out of thirty six cases majority of entomological inhabitants were found in field the reason for presence in field is they are diurnal creatures which are

in search of food only in day time, and humidity also plays a pivotal role in insects inhabiting in day time. Another reason for insect foraging in field only is that they are cold blooded creatures where they require enormous humidity to maintain their body temperature. The other important reason is, insects can only function if the air temperature is warm enough for their metabolism to work properly, if it is too cool at night they become lethargic and slow down or stop completely. By hiding they avoid predators, but they do gather around some mild heat source during the cold of the night near lamps.

Research question-2

Musca domestica has its origin from central Asia, these are one of the most extensively scattered insect found in connection with humans all over the world. House flies are found in temperate regions, and are abundantly found in warm seasons, but some adults survive in winter seasons in temperate areas. They feed and breed on animal feces and garbage, dung heaps garbage cans and mammalian road kill, these are the best environments for the larvae to develop, other breeding medium includes rotten fruits and vegetables, old broth, boiled eggs and even rubber

(marshall,2006;Robinson,2005;SWANN and papp-1972), its primary diet is carnivore and are called coprophage. Its habitat includes all non- marine alfrescos. With respect to death scene area *Musca domestica* arrives on the corpse or carcass after they bloat and oviposit and starts the process of procreation. Back ground odour induces adaptation and sensitization of olfactory receptors in the antennae of *Musca domestica*, the olfactory system detects decomposition of corpse and help in arriving on the corpse.

When in death scene area, *Musca domestica* species was associated on the corpse, a non- significant association was observed in three stages. In a death scene area, we witnessed *Musca domestica* species in shelter, out of thirty six cases in four cases *Musca domestica* existed and in two cases it was non existant, with respect to alfresco out of thirty cases *Musca domestica* existed in four cases and it was non existant in fourteen cases, with respect to water out of thirty six cases twelve cases of *Muscadomestica's* existence was none.

Chrysomya megacephala commonly known as oriental latrine fly and it is a member of Calliphoridae family. Its body is greenish metallic blue in colour. This fly

arrives on the corpse soon after the death and oviposits on the corpse, its eggs are oval in shape with one flat face and other side is bulged. *Chrysomya megacephala* has a vast geographical distribution. The developmental stages of *Chrysomya megacephala* include egg, larva and pupa. It lays up to two hundred to three hundred eggs often in human faeces, meat and fish (Doe, Peter E). larval phases comprise first, second and third instar (M Lee. Goff). The eggs approximately take twenty four hours to mature, while the larvae take 5.4 days and pupae 3.5 days (Rufant M. Gabre; Fatma K. Adham, Hsin chi 2005). The population and body size of the insect is immensely influenced by the temperature (Regada C Godony WA 2006). The life span of this fly is approximately seven days (Doe, Peter E).

Chrysomya megacephala is an imperative fly in forensic science because it is the first to arrive on the corpse. The time of death is effortlessly determined when the fly's larvae are present on the corpse. In many forensic entomology cases *Chrysomya megacephala* are present on the putrefied corpse. Mitochondrial DNA is the chief method utilised to determine which sub family is present on the corpse (Shiuh-Feng.S.yeh T. 2008) the species has a vast

geographical distribution and makes it beneficial in forensic cases. Larval dispersion arrangement of *Chrysomya megacephala* also make it forensically significant. Larvae crawl away from the food source and find a safe place to metamorphosise, by this forensic entomologists are able to precisely evaluate the post mortem interval (Byrd, James & James L Castner. 2001).

When in death scene area, *Chrysomya megacephala* species was associated on the corpse, a non- significant association was observed through that, insect species differed from all three stages, we witnessed out of thirty cases with respect to shelter we found the insect was present in two cases and absent in four cases, out of thirty six cases with respect to field we found the insect was present in seventeen cases and absent in one case, out of thirty six cases with respect to water we found the insect was present in seven cases and absent in five cases disclosing that the insect species differ in all three phases.

Conclusion

The most epitomic specialised sector of forensic science is forensic entomology. It has corroborated in umpteen number of

cases where forensic entomologists are the beneficiaries of this science which has helped in cracking numerous cases. This part of science requires special equipment and facilities in upholding the values of obscured part of criminology and forensic science. Testimonials of various cases where insects play a pivotal role in cracking mysteries of death in death scene area are provided. Eventually each and every stage of transmogrification of entomological inhabitants immensely paves the way for ascertaining the post mortem interval of a corpse with respect to shelter, field and water in a death scene area.

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