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ADVANCES IN CRIME INVESTIGATION (FORENSIC ENTOMOLOGY)

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ABSTRACT

Insects are the dominant multicellular life form on the planet. Insects have evolved diverse life styles and have dominated over every habitat. Benefits from insects are more than economic or environment and are ultimately associated with human survival. Insects play an important role in criminal investigations proving to be an apt and permanent witness of the crime forensic entomology is the recent innovation of science that includes the study of insect biology to criminal matters. The hide range of applications for forensic entomology on the bases of investigation of insects has given new horizon to criminal investigation Insects act of evidence.

I. INTRODUCTION

Forensic Entomology draws evidence applicable to civil and criminal cases from the biology of insects. It has been categorized into medico- legal forensic entomology urban forensic entomology and stored product forensic entomology. Medico legal forensic entomology is distinct in that its standard of evidence is governed by criminal laws, while the others are largely judged under the less stringent evidentiary standards of civil law.

Hundred of arthropods species are attracted to a decaying corpse, primarily flies (Diptera), bettles (coleoptra) and their larval stages, but also mites, isopods and nematodes can be found. These animals feed, live or breed in and on the corpse, depending on their biological preferences and on the state of decomposition. Since arthropods are by far the longest and most important biological group on earth (they out number even plants) they can be found in a wide variety of locations, including crime scene. This opens a wide range of application for forensic entomology on the basis of investigation of insects recorded from crime scenes and corpse (Benecke, 2008)

What is forensic Entomology:-

Forensic entomology is the application and study of insect and other arthropod biology to crime matters. It also involves the application of the study of arthropods, including insects, arachnids, centipedes, millipedes and crustaceans to legal cases. It is primarily associated with death investigations, however it may also be used to detect drugs and poisons, determine the location of an incident, and find the presence and time of the inflication of wounds. Insect evidence may show that the body has been moved to a second site after death, or the body has been distributed at sometime either by animals, or by the killer returning to the scene of the crime. However, the primary purpose of forensic entomology today is determine elapsed time since death.

Forensic Entomology

1. Urban Entomology
2. Stored product Entomology
3. Medico-Legal Entomology

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1. Urban Entomology:- It is the branch of forensic entomology which deals with pest infestations in buildings or gardens that may be basis of utigation between private parties and service providers.

2. Stored Product Entomology:- It is the branch of forensic entolomology used in litigation over infestation or contamination of commercially distributed foods by insects.

3. Medico-Legal Entomology:- It is the branch of forensic entomology used in utigation over criminal actions by people, in cases such as murder, rape, suicide, physical abuse etc.

Why are Insects used in Forensic Science?

- In most seasons and environment, insects colonize a dead body almost immediately after death.
- Their rate of development and species dynamics over time can be used to accurately determine time since death.
- After 72 hours, entomological evidence is the most accurate method to determine the elapsed time since death.

The History of Forensic Entomology

- First recorded use in 13th century in china.
- Became quite commonly used in Europe through out the 20th cenury.
- Popularity increased in North. America in the 1970's
- Today: used quite extensively and commonely in homicide investigations.

II. METHOD

1. Collection:- Samples of insects should be collected from different area of the body, from the clothing and from the soil, carpet etc.

There are two main insects groups on bodies flies (diptera) and Beetles (coleoptera)

Flies can be collected as:-

1.1 Eggs (masses)

1.2 Larval or maggots (size 1.2mm to 17mm)

1.3 Pupae / empty pupal cases

1.4 Adults

1.1 Eggs are very tiny but are usually laid in clumps. Half should be preserved in 75% alcohol and rest should be placed in vial with a little damp tissue paper to prevent dehydration

1.2 Maggots:- Collect a range of sizes These will be found crawling on or hear the remains and may be in maggot masses.

Site of maggot masses

Collect sample of maggots from different areas of the body and the surrounding area and peep them deparate.

DON'T FORGET THAT HALF SHOULD BE KEPT ALIVE

Preserves the specimen by immersing them in hot water for few minutes, them in 75-90% alcohol.

1.3 **Pupae/Pupal Cases:-**These are extremely important and easy to miss. Often found in clothing or soil near the body Like dry secure areas away from wet food source.

1.4 **Adult Flies:-** Less important only of use in indicating which species of insect are likely to develop from the corpse.

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Beetles:- Can be found as adults, larval or grubs, pupae and also as cost skins. All stages are equally important . They move fast and are often found under the body and under clothing.

2.1 Labeling:- Insects Collected from one part of the body should be kept separate from those from another area. Each vial should be labelled with

- **Area of body/soil**
- **Data and time of collection**
- **Name of collector**
- **Stage.**

2.2 Handling:- Most specimens are fragile and are probably best picked up with gloved fingers which are often gentler then forceps.

2.3 Packaging:- Insects should be taken to the entomologist as soon as possible. Should be either couriered or hand delivered packed in cardboard box as this has lots of air.


DISCUSSION

Major Group of Insect Associated With Cadavers:-

1. Flies (Order:Diptera)

- Blowflies (Calliphoridae)
- Flesh Flies (Sarcophagidae)
- House Flies (Muscidae)
- Cheese Skippers (Piophilidae)
- Black Soldier flies (Stratiomyidae)

2. Beetles (Order: Coleoptera)

- Carrion beetles (Silphidae)
- Rove beetles (Staphulinidae)
- Hister beetles (Histeridae)
- Scarab beetles (Scarabacidae)
- Carcass beetles (Trogidae)

3. Mites (Class: Acari)

- Macrocheles mites
- Poccilochirus mites
- Tyroglyphidal mites

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- Oribatidal mites

4. Moths (Order:Lepidoptera)

Clothes-moths (Tineidal)

5. Wasps, Ants and Bees (Order: Hymenoptera)

- Wasps (Family:Vespidae)
- Ants (Formicidae)
- Bees (Apoidea)

1. Flies (Order:Diptera)

Flies (Order:Diptera) are often first on the scene. They prefer a moist corpse for their offspring (maggots) to feed on. The most significant types of fly include.

1.1 Blow Flies-Family Calliphoridae:- Flies in the family are often metallic in appearance and between 10-12 mm in length. In addition to the name blowfly, some members of

Important Implications for forensic work

- Eggs an a corpse cannot belong to flesh flies.
- In a calculation of PMI, when counting backwards from the stage, the larval are at a time of discovery, you would n't allow time for egg development as you do with blow flies.
- About as quick as blowflies to find a corpse, fly in worse weather conditions than blow flies so many arrive first under those conditions.
- Commonly go indoors, so often associated with bodies inside a house.

1.2 House fly-Family Muscidae:- It is the most common of all flies found in homes and is often considered a pest that can carry serious diseases. The adults are 6-9 mm long with grey thorax and four longitudinal dark lines on the back. Genus Hydrotaea is of particular forensic importance.

Hydrotaea diabolus (dump fly), arrives on scene after much decay and it scceeds several other species. When hydrotaea is found during an investigation it is usually a sign that the corpse was not burned that the calliphoridae species or blow fly phase has been and completed. This can be facultative predators in their 2nd and 3rd instars this means that they can feed on one another or other fly species.

Important to investigators because they must include additional time to the PMI Since they have eaten flies or larval that preceded their because the difference in 1 hour of death could change the cause of death.

This family are known as BLUE BOTTLE, FLY, CLUSTER Fly, GREEN BOTTLES OR BLACK BLOW FLY. Term 'Blow fly' may come from the fact that the gases of putrification produced as a result of maggot infestation cause meat to become bloated-Fly blown. A characteristic of the blow fly is its 2 segmented antennal. Hatching from an egg to the first larval stage takes from 8 hrs to 1 day. Larvae have three stages of development (Instars), Each stage is separated by a molting event. Worldwide, there are 100 known species of blow flies, with 228 species in the Neotropics. The typical habitat for blow-flies are temperate to tropical areas that provide a layer of loose, damp soil and litter where larvae may thrive and pupate.

The forensic importance of this fly is that it is the first insect to come in contact with carrion because they have the ability to smell death from upto 10 miles (16 km) away.

1.3 Fresh flies- family Sarcophagidae:- Most fresh flies breed in carrion, dung, or decaying material, but a few species lay their eggs in the open wounds of mammals; hence their common name. Characterstics of the flesh

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fly is its 3-segmented antennae They are medium sized flies with black and grey longitudinal stripes on the thorax and checkering on the abdomen. Flesh flies differ from blow flies in that the female do not lay eggs. The eggs hatch inside the female and deposits first instar larval directly on the carrior (Viviparous)

1.4 Cheese Flies-Family Piophilidae:- Most are Scavangers in animal products and fungi. The best known member of the family is piophila casei. It is a small fly, about 4mm long, found world wide. The fly's larva infests cured meats, smoked fish, cheese and decaying animals and is called cheese skippers for its leaping ability. Forensic entomology uses the presence of piophila casei larvae to help estimate the data for human remains. They donot take up residence in a corpse unti three to six months after death.

1.5 Black Soldier fly:- Family:- Stratiomyidae:- Have potential for use in forensic entomology. The larvae are common scavangers in compost heaps are found in association with carrion. Larval range in size from 3-10 mm. Adult fly is a mimic, very close in size, color and appearance to the organ pipe mud dauber wasp.

Some Others Flies Associated Are:-

- Coffin Flies (Phoridae)
- Lesser corpse flies sphaenoceridae)
- Black scavenger (Sepsidae)
- Sun Flies (Helomyzidae)

2. Beetles (Order:-Coleoptera)

Bettles (Order Coleoptera) are generally found on the corpse when it is more decomposed. In drier conditions, the beetles can be replaced by moth flies (Phychodidae)

2.1 Carrion Beetles-Family Silphidae:- Adupt silphidae have an average size of about 12mm. They are also referred to as burying beetles because they dig and bury small carcasses underground. There are over 200 species in this family, but the ones that eat dead flesh are those that belong to the subfamily Necrophorinal. Both parents tend to their young and exhibit communial breeding. The male carrion bettle's job in care is to provide Protection for the breed and carcass from competitors. They feed on larvae.

2.2 Rove Beetles-Family Staphylinidae:- Are elongate beetles with small elytra (wing cover) and large jaws like other beetles inhabiting carrion, they have fast larval development with only three larval stages. Creephilus sps are common predators of carrion, and since they are large, are very visible components of the faund of corpses. Some adult staphylinidae are early visitors to a corpse, feeding on larvae of all species of fly, including the later stages of decomposition. Staphylinids can also tear open the pupal cases of flies, to sustain themselves at a corpse for long periods.

2.3 Hister Beetles- Family Histeridae:- They are among the first beetles to arrive at carrion. Adult histerids are usally shiny beetles (black or metallic- green) Which have an introverted head. They generally hide under a corpse during the daylight, and only become active at night when they enter the maggot- infested part of the corpse to capture and devour maggots. Among the first beetles to arrive at a corpse are histeridae of the genus Saprinus saprinus adutts feed on both the larvae and pupae of all species blowfly.

2.4 Scarab Beetles-Family Scarabacidae:- Scarab beetles may be any one of around 30,000 beetle species worldwide that are compact, heavy- bodied and oval in shape. The flattened plates, which each antenna terminates, are filled together to form a club. The outer edges of the front legs may also be toothed or scalloped.

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Scarab beetles range from 0.2 to 4.8 in length. These species are known for being one of the heaviest insect species. They arrive at the scene when the body is completely dry.

2.5 Carcass Beetles-family Trogidae:- Carcass beetles are large beetles with very thick exoskeletons and uniform dark coloration. They are among the last beetles to inhabit a carcass. They feed on direct remains such as skin and ligaments both adults and larvae feed on the carcass and the larvae live in vertical burrows underneath it when they are not foraging.

Some other Beetles Associatted Are:-

- Ham beetles (clenridae)
- Skin/ Hide beetles (Nitidulidae)

3. Mites (class: Acarl)

Many mites (class Acari) feed on corpses with Macrocheles mites common in the early stages of decomposition, while Tyroglyphidae and oxbatidae mites such as Rostrozetes feed on dry skin in the later stages of decomposition.

Necrophorus beetles often carry on their bodies the mite Poecllochirus which feed on fly eggs. If they arrive at the corpse before any fly eggs hatch into maggots, the first eggs are eaten and maggot development is delayed. The may lead to incorrect PMI estimates.

4. Moths (Order Lepcdoptera)

Moths (Order Lepcdoptera) Opecifically clothes moths family Tineidae. Most species of moth are nocturnal but there are crepuscular and diurnal species. Moths feed on mammalian hair during their larval stage. S and may forage on any hair that remains on the body. They are amongst the final animals contributing to the decomposition of a corpse.

5. WASPS, ANTS AND BEES (ORDER: HYMENOPTERA)

Wasps, ants and bees (order Hymenoptera) are not necessarily necrophagous. While some feed on the body, Some are also predatory, and eat the insects feeding on the body. Bees and wasps have been seen feeding on the body during the early stages. This may cause problems for murder cases.

Wasps- Family Vespidae:- Wasps exhibit a range of social difficulty, from private living to eusoccial colonies. The non- breeding creature cares for the young or defend and supply for the group.

Ants- Family Formicidae:- Among the most widespread and damaging of introduced species are ants. Many ants share some characteristics that ease their preamble and subsequent range expansion. One feature of their importance is the ability to establish numerically large, ecologically dominant colonies.

Bees- Super family Apoidea:-Forensic entomologists have used bees to several cases when parents have used bees to sting their children as a form of discipline. Also, entomologists have been called upon to determine whether or not bees or wasps have been the cause of an accident.

There are many different types of insect studied in forensic entomology. There are many variations due to climatic condition like moisture levels, sun exposure, like air exposure etc.

OTHER USES FOR INSECTS IN FORENSIC SCIENCE

The body may have been moved after death from the scene of the killing to a hiding place. Some of the insects on the body may be native to the first habitat and not the second. This will show that not only was the body moved but it will also give indication of the type of area where the murder actually took place.The body may

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have been disturbed after death, by the killer returning to the scene of the crime. This may disturb insect's cycle and the entomologist may be able to determine not only the date of death but also the date of the return of the killer.

The presence and position of wounds, decomposition may abscure wounds. Insects colonize remains in a specific pattern, usually laying eggs first in the facial orifices, unless there are wounds, in which case they will colonize these first, then proceed down the body. Eg: maggot activity on the palam of the hands indicates the probable presence of defense wounds.

The presence of drugs can be determined using insect evidence. There is often not enough flesh left to determine drug presence but maggots bioaccumulate so can be analyzed to determine type of drug present.

Child or senior abuse/ Neglect:- Some insects will colonize wounds or unclean areas on a living person known as cutaneous mytasis. In these cases, the victim is skill alive but maggot infested. A forensic entomologist will be able to tell when the wound or abuse occurred.

CHALLENGES TO FORENSIC ENTOMOLOGY

Temperature:- Need temperature data to get a precise idea of insect development speed.

Season:- Forensic entomology is only valuable during certain times of the year (spring, summer, fall) when insects are present

Exclusion of Insects:- Freezing, burying or wrapping a body can prevent insects from colonizing it.

More Research is needed:- Insect succession varies from geographic region and the species and time of colonization must be developed for all areas using this typ[e of evidence.

Time consuming:- The results are not immediate, as it takes time to rear the insects. DNA evidence is now being developed to speed up identification of immature specimens.

Drugs:- The presence of drugs may affect the development of the insects. Work is planned to determine the effects of common narcotics on insects

"IN CONCLUSION, INSECTS ARE EVIDENCE! Forensic entomology is a very useful method for determining elapsed time since death after 72hrs and can be used earlier. It is accurate to a day or less or a range of days and may be the only method available to determine elapsed time since death. It is vital that the insects are collected property and its accuracy depends on this and on suitable conditions for insects."

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