

# Solving Crimes by Using Forensic Entomology

Dr. Deborah Waller  
Associate Professor of Biology  
Old Dominion University

# The Scenario

The following is a hypothetical crime that was solved using insect evidence. Although fictional, this crime represents a compilation of numerous similar forensic entomology cases tried in the legal system where insects helped identify the murderer.

# The Crime Scene

Pamela Martin, a 55 year-old woman, was found deceased in a state of advanced decomposition on March 30<sup>th</sup>. The body was discovered by her husband John on a path leading to a mountain cabin owned by the couple.

The Martins had driven up to the cabin on March 1<sup>st</sup>, and John had left Pamela there alone while he completed a job in the northeastern region of the state.



# The Victim

Pamela Martin was a former school librarian who devoted her retirement years to reading and gardening. She took medication for a heart condition and arthritis and generally led a quiet life. Pamela was married for 30 years to John Martin, a truck driver who was often gone for months at a time on his rounds. They had no children.



# The Cabin

The cabin was isolated with closest neighbors several kilometers away. There was no internet access and cell phone service was out of range. The couple frequently drove up there to do repairs, and John often left Pamela alone while he made his rounds throughout the state.



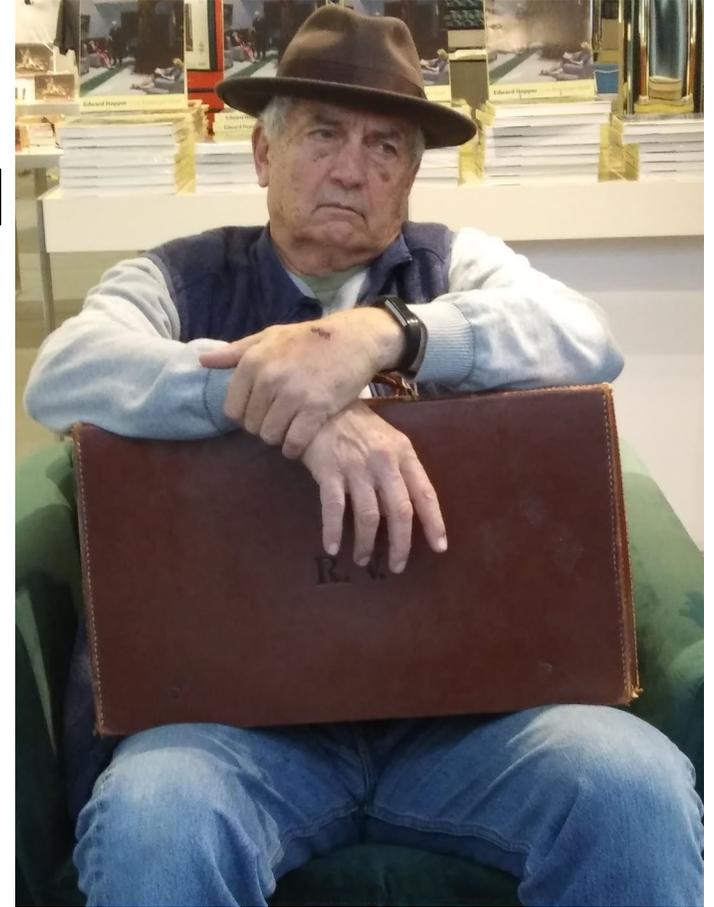
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# The Police

The police and coroner arrived on the scene March 30<sup>th</sup> after John called them using his Citizen Band radio when he discovered Pamela's body. I went along with my forensic team to collect entomological evidence as the police interviewed John and local neighbors to record their statements.

# The Husband

John Martin held a series of low-paying sales jobs in the past. John was concerned he would soon be fired as a truck driver. Police discovered that John had taken out a \$500,000 life insurance policy on Pamela three months earlier. John was the prime suspect in the case.



# The Owner of the General Store

The general store, a 10 km hike from the Martin's cabin, was owned and operated by Julia Snow. She had lived in the area all her life and knew everyone in town and all the gossip. Julia told police that she had not seen Pam Martin since the couple had stopped at the store on their way to the cabin on March 1<sup>st</sup>.



# The Nearest Neighbor

Ashley Bright was the neighbor in the next cabin 5 km away. She had worked in the general store as a teenager, but now police believed she relied on petty thievery and drug deals to survive.

Ashley said she had met the Martins only a few times and had not seen Pamela since the previous year. However, she said that Julia had told her the Martins had driven to the cabin March 1<sup>st</sup>.



# The Question for Forensic Entomology

Did Pamela Martin die on March 1<sup>st</sup> when she arrived at the cabin with John? No one had seen her since then.

If she died March 1<sup>st</sup>, John was the likely suspect.

Forensic entomology can determine when the victim was killed by examining the species and stages of insects on and around the body.

As a body decomposes, different species arrive on the corpse in a predictable pattern of insect succession.

# Stages of Decomposition

Bodies typically undergo the following five stages of decomposition. Temperature and environmental conditions can alter the rate of transition between stages. Pamela Martin's body was in the decay phase when she was found on March 30th.

**Fresh:** Lasts from time of death until bloating stage begins.

**Bloated:** Bacteria release gases which fill the body.

**Decay:** Gases escape when decomposers break the skin.

**Post decay:** Only skin, cartilage and bone remain.

**Skeletal:** Only bones and hair remain.

# Insects Associated with the Fresh Stage

Diptera (flies) adults, especially blow flies (Calliphoridae) and flesh flies (Sarcophagidae), arrive early at a corpse. Adults may feed and oviposit on wounds or natural openings.



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["Lucilia sericata \(Common Green Bottle Fly\)"](#) by [Arthur Chapman](#) is licensed under [CC BY-NC 2.0](#)

# The Blow Flies (Family Calliphoridae)

The Calliphoridae are usually the first insects to arrive at a corpse. They are attracted by chemicals released at death and seek openings (natural orifices or wounds in the body) to feed on fluids and lay their eggs. Blow flies are the most important forensic insects in solving cases.



"Greenbottle flies" by [Martin Cooper Ipswich](#) is licensed under [CC BY 2.0](#)

# Blow Fly Life Cycle

Eggs are laid on a body within minutes of death.

Larvae hatch out and go through 3 instars as they grow larger.

The 3<sup>rd</sup> instar larvae crawl away from the body to form barrel-shaped pupae.

Adult flies emerge from the pupae, leaving behind the hardened pupal case.

Time spent in each stage depends on the temperature.



# Insects Associated with the Bloated Stage

Fly eggs oviposited during the fresh stage produce larvae (maggots) that may feed internally in the body.

Adult flies, including the blow flies, flesh flies, latrine, dump and house flies continue to arrive in the Bloat Stage and oviposit on the corpse.



Coleoptera Rove  
beetles begin to arrive.

# Insects Associated with the Decay Stage

Fly maggots, including Calliphoridae and Sarcophagidae, feed during the decay stage and then disperse from the body and pupate. Other Diptera families including black scavenger flies, small dung flies, dung flies, soldier flies, and scuttle flies become active.

Coleoptera beetles including the Silphidae carrion beetles and other families become numerous.



# Insects Associated with the Postdecay Stage

In this stage, Diptera adults and maggots become less numerous and the Dipteran family of cheese skippers arrives. Coleoptera beetle adults and larvae become more abundant.

Dermestidae beetles are especially important in removing skin and cartilage from the skeleton. This beetle is used by museums to clean skeletons.

Lepidopteran moth families may arrive.

Predators, parasites and soil arthropods increase in numbers during this stage.

# Insects Associated with the Skeletal Stage

Most carrion insects have left the corpse by this stage.

Soil insects that increased in numbers in the postdecay stage now gradually decrease to normal levels.

# Forensic Entomology Procedures

- 1) The appropriate tools should be brought to the crime scene.
- 2) Environmental data from the corpse and surroundings should be collected.
- 3) Insects should be collected from the body.
- 4) Insects should be collected from the surroundings.
- 5) The correct number and type of insects should be collected.
- 6) Insects should be preserved appropriately.
- 7) Chain of custody must be followed from the beginning.

# Tools to Bring to the Crime Scene

## A Forensic Entomologist toolkit:

Tool box

Protocol sheets (Amendt et al. 2007)

Pencil or water-proof or alcohol-proof ink pen

Labels

Forceps, fine-point and blunt, with and without tension

Spoons for maggots

Fine paint brush for eggs

Vials and storage boxes

Shovel or trowel

Plastic or paper bag

Tissue

Thermometer, and data logger for long-term data collection

Ethanol 70-95%

Camera, still and/or video

Material to seal vials and containers

Cooler and freezer packs to store insect specimens

Insect net

# Microclimate Data to Collect

Records of the following conditions should be made:

Condition and position of the corpse

Detailed description of the crime scene

Temperature of air, body, ground, soil to 10cm, larval masses

Data on weather between dates when deceased was missing and then discovered from local meteorological stations

Data from data logger for subsequent days to check accuracy of the local meteorological station

# Where to Collect Insects from the Body

Insects should be collected from everywhere on the body, including:

Natural orifices in the body

Wounds in the body

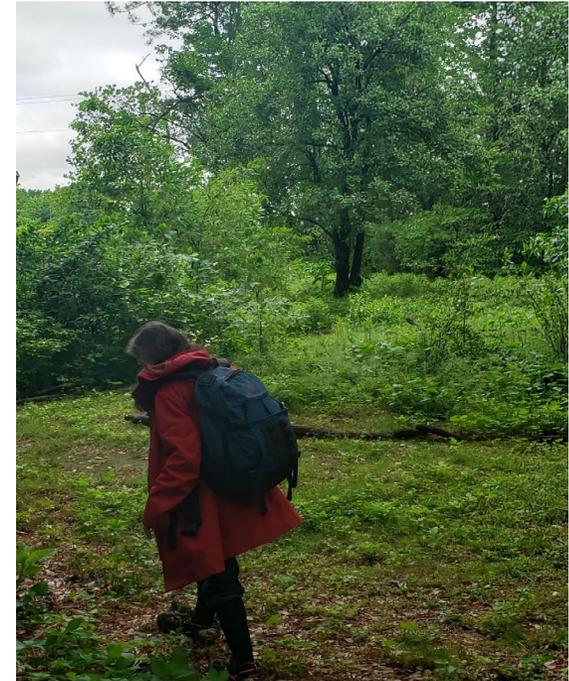
Underneath the body

In clothing and shoes where insects might hide

From any material (carpet, plastic) in which the body was wrapped.

# Where to Collect Insects from the Surroundings

**Outdoors:** The area should be searched for insects up to 2-10m from the body, including looking under stones and logs, and netting flying insects near the body. Soil samples should be taken up to 2m from the body and dug down at least 10cm. Control samples of insects should be obtained >10m from the body to assess the insect abundance in the area.



# The Number of Insects to Collect

Every size and type of insect found on/near the body should be collected in separate vials.

## **How many to collect of each category:**

- 1) All specimens should be collected of species/stages that have less than 100 specimens.
- 2) For very numerous species/stages, at least 1-10% should be collected.



# How to Preserve Insect Stages

**Dead Insects:** Place dead insects and/or their parts (cast exoskeletons, etc.) directly in a glass vial with 70-95% ethanol.

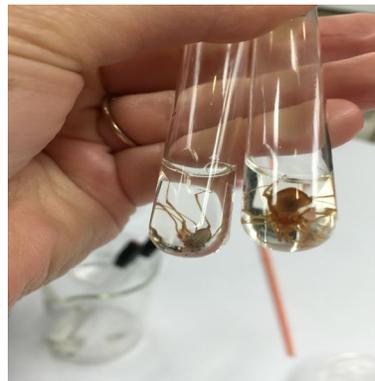
**Eggs:** Eggs should be placed on moist paper in a vial with air flow until they hatch. New larvae may be either placed directly in 70-95% ethanol, or reared according to species-specific conditions.

**Live Larvae:** All larvae should be placed initially at 2-6°C in an escape-proof container with air flow with paper towels to absorb fluids. Larvae should then be reared under species-specific conditions. To preserve larvae, place in hot water (80°C) for 30 seconds or freeze at -20°C for 1 hour. Once the larvae are dead, they can be placed in 70-95% ethanol.

# How to Preserve Insect Stages, continued

**Pupae:** Pupae can be placed initially in a vial with air flow at 2-6°C. They may then either be allowed to emerge as adults, or frozen at -20°C for 1 hour and then placed in a vial of 70-95% ethanol.

**Live Adult Stages:** Live adults should be killed by placing them in a vial at -20°C for 1 hour. Then they should be placed in vials with 70-95% ethanol for preservation. Newly emerged insect adults should be allowed to harden their wings first before freezing.



# Chain of Custody

Forensic entomologists must document the chain of custody by keeping the appropriate records (Amendt et al. 2007):

- 1) Name of the person in authority
- 2) Record of the date, time and location of the collections
- 3) A code number for the entire sample that is placed on every vial and piece of evidence collected from the crime scene
- 4) A label on each vial with the code, contents and specific site of collection
- 5) Vials should be sealed to protect chain of custody

# Entomological Results

Our forensic entomology team collected large maggot masses from the victim's mouth and nose and from a wound in the abdomen. The wound was later confirmed by the coroner to be made by a 20 x 4cm knife blade. The maggots were primarily late third instar blow flies, species *Phanaecia sericata*. This species begins to pupate after 10 days at 20°C, which was the average temperature in the area during March according to the nearest weather station. Despite exhaustive search, no pupae or pupal cases were found near the body, which would be expected if the maggots had been active March 1-19<sup>th</sup>. Our conclusion was that Pamela had been killed at the earliest by March 20<sup>th</sup>.

# The Suspect

John Martin had motive, and no one had seen Pamela alive since they drove up to the cabin together March 1<sup>st</sup>. Insect evidence indicated Pamela was alive through March 20<sup>th</sup>. If John was the killer, he must have returned to the cabin on that date. However, John's job contacts confirmed to police that John had made all his stops in the northeast on time. The mileage on John's truck was consistent with John driving his regular route in March, and there was no excess mileage to indicate that John had returned to the cabin early.

# Suspect's Alibi is Confirmed

Police considered that John may have returned to the cabin secretly by car or bus. However, he had maintained his usual truck route schedule so that seemed unlikely. Police also speculated that an accomplice of John's may have killed Pamela, but John tended to keep to himself and no accomplices could be identified.

Suspicion turned to the locals, including Julia Snow and Ashley Bright.

# Julia Snow

Julia Snow had no motive to murder Pamela Martin. Pamela was a regular customer at the general store whenever she visited the cabin. Julia recalled that Ashley Bright came to the store around March 20<sup>th</sup>. Ashley was disheveled and appeared to have blood on her shirt.



# Ashley Bright

Police obtained a search warrant for Ashley's cabin and found empty prescription vials for Pamela Martin's medications. The Martin's kitchen knife, which fit the description of the murder weapon, was recovered from the septic tank. Apparently Pamela discovered Ashley in the act of stealing her much needed medicines and was stabbed with her own knife when she tried to recover them.



# The Flies Had the Final Word!



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