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ENTOMOLOGICAL RESEARCH AS A FORENSIC TOOL IN INTERNATIONAL PRACTICE

Alongside traditional methods of forensic investigation, modern practice increasingly relies on additional specialized techniques to obtain more accurate and detailed information about the circumstances of death. One such supplementary discipline is forensic entomology, which studies insects and their developmental patterns on human remains. By examining species composition, growth stages, and environmental conditions, this field provides investigators with valuable biological data that can assist in clarifying timelines and supporting the overall reconstruction of events.

The term “forensic entomology” is derived from the Latin term *forensic*, meaning “of or before the forum,” and the Greek words *entoma* - insect and *logos* - science. Historically, in Ancient Rome, when the cause of death was unknown, the body was displayed in the forum for a “forensic examination” [1], where early observations of insects played a role in judging the time and conditions of death.

Forensic entomology is the application of insect biology to legal investigations, it also has ancient Chinese origins. The Song dynasty text *The Washing Away of Wrongs* described one of the earliest known uses of insect evidence in a murder investigation. In China, systematic research advanced significantly only in the late 20th century, influenced by progress in Europe and North America.

Accurate identification of sarcosaprophagous insects is crucial for determining the postmortem interval (PMI). Since the 1990s, Chinese researchers have developed strong taxonomic foundations supported by molecular tools such as mitochondrial DNA analysis and SNP genotyping. Developmental studies of blowflies, flesh flies, and beetles at controlled temperatures allowed scientists to correlate larval growth with elapsed time. Researchers also studied how drugs (e.g., morphine, ketamine, methamphetamine) alter insect development, since these substances may distort PMI estimates. Since 2020, Chinese regulations officially recognize insect evidence as valid for PMI estimation, with over 20 documented cases of its successful use [2].

Forensic entomologists are often included in investigative teams to determine PMI during corpse examination. According to modern forensic methodology, the expert may use various instruments to measure larval weight, length, developmental stage, and environmental factors. The work of a forensic entomologist can be divided into five steps:

1. Visual observation and marking at the crime scene.
2. Data collection at the crime scene.
3. Collection of samples from the body before it is moved.
4. Collection of environmental samples before the remains are relocated.
5. Collection of samples found directly beneath the body (the body's resting place).

According to forensic standards described, crime scene work in forensic entomology must follow strict protocols:

1. Every contact leaves a trace.
2. Photographing and video documentation are mandatory before any sample is touched. The originality of samples may be questioned in court without this documentation.
3. Environmental conditions such as ambient temperature, soil temperature, humidity, and sun exposure must be recorded. These

values significantly affect larval development because insects are poikilothermic.

4. Meteorological data from at least one week prior to finding the body should be obtained from a meteorological station.

5. Temperature of the corpse should be taken from the liver; if decomposition is advanced, surface temperature is recorded [3].

An entomologist should first determine the general characteristics of the location where the body was found - whether it is a rural or urban area, a forest, near a lake or a river, in a dry or humid environment, or inside a building, basement, and so on. It is essential to identify the insect species typical for that environment as well as those present on the body itself.

The expert should examine the developmental stages of the insects found, noting the presence and combinations of adult insects, larvae, eggs, pupae, empty pupal cases, or shed larval skins. It is also necessary to record which types of insects are found on and around the body, such as beetles, ants, or parasitic insects.

Additionally, the entomologist must observe the insects' activity - how they move or fly, and within what range - both on the corpse and in its immediate surroundings. The precise location of the body should be marked according to the cardinal directions (north, south, east, west). Finally, it is important to indicate which parts of the body are in direct contact with the insects, taking into account factors such as sunlight and shade [4].

A common method for examining a scene that contains entomological evidence is the spiral search technique. The examination begins directly at the body, after which the specialist slowly moves outward along an expanding spiral, or, alternatively, from the outer perimeter toward the centre, ensuring that no specimens are overlooked. Insects may disperse up to six meters from the body, so the surrounding area must be inspected thoroughly. Special attention is given to hidden locations such as folds of clothing, nostrils, ears, wounds, natural body openings, as well as spaces under carpets, inside shoes, or in ventilation openings, where larvae and pupae may be concealed.

Recent advances in forensic entomology have expanded its use in both human and wildlife investigations:

Entomotoxichology: this branch studies toxins, poisons, and drugs found in insects feeding on corpses. Even when human tissues are

decomposed, substances such as heroin, cocaine, arsenic, or phenobarbital can be detected in maggots or their remains using advanced methods like HPLC, GC-MS, and LC-MS. This helps determine poisoning or drug use before death.

Wildlife Forensic Entomology: applied in cases of illegal hunting or poaching, insect evidence helps estimate the postmortem interval and cause of death in animals. Notably, insect analysis aided investigations of tiger deaths in India's wildlife reserves.

Instant Identification (DART-HRMS): this technology allows rapid, non-destructive analysis of insect eggs, identifying species instantly through amino acid profiling.

Molecular Identification: modern DNA-based methods such as PCR-RFLP and DNA barcoding replace traditional morphological techniques, allowing accurate identification of insect species at any life stage.

Human DNA Detection from Maggots: DNA extracted from maggots' gut contents can reveal the victim's genetic profile, even when human remains are too decomposed for direct sampling.

These innovations make forensic entomology faster, more precise, and valuable for solving complex criminal and environmental cases. Forensic entomology serves as a complementary tool that supports traditional investigative methods. By examining insect species, their development stages, and environmental conditions, specialists can assist in estimating the postmortem interval when other approaches are limited or unavailable. Accurate documentation and careful sample collection ensure that this biological evidence can be properly interpreted.

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FEATURES OF THE INVESTIGATION OF WAR CRIMES BY UNITS OF THE NATIONAL POLICE OF UKRAINE

The Russian Federation's full-scale armed aggression against Ukraine has brought to light a significant problem in the work of the criminal police, namely their lack of experience in investigating international crimes (war crimes, genocide, etc.). This problem was catalyzed by the significant number of crimes which poses a challenge for their documentation and classification. The main component of this problem is the insufficient level of training of investigators, prosecutors and other law enforcement officials in the field of international humanitarian law, which manifests itself in difficulties in identifying the constituent elements of crimes, analyzing the nature of international armed conflict and ensuring procedural procedures for the accused. The start of the Russian Federation's large-scale armed invasion of Ukraine and the subsequent introduction of martial law had a significant impact on the functioning of all units of the National Police and other state structures.