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EDITORIAL

Novel Approaches and Advances in Forensic Entomology

Keeping up with the times: The application of innovative techniques in forensic entomology

Advancements in technology have meant that there have been significant developments in the field of forensic entomology, allow researchers to develop tools to more accurately identify entomological evidence, as well as provide more accurate estimates of postmortem interval (PMI).

Since its inception in the early thirteenth century (Benecke, 2001), the use of insects in medico-legal investigations has often been met with trepidation. However, over time the reluctance of legal professionals to allow entomological evidence into a court of law has waned, and currently, entomological evidence is accepted in many countries as part of criminal proceedings (Du Plessis & Meintjes-Van der Walt, 2004; Hall, 2021). With the advancement of scientific techniques and technologies, and the introduction of artificial intelligence (AI) tools, it is paramount that the scientific community is constantly evolving and developing novel methods to analyse entomological samples.

The development of forensic entomology accelerated in the twentieth century with advancements in biology and technology. Researchers began to catalogue the predictable patterns of insect colonization on corpses (Anderson & VanLaerhoven, 1996; Eberhardt & Elliot, 2008), noting how environmental factors such as temperature influence insect activity and development. Studying the influence of temperature on the developmental rates of necrophagous insect species is pivotal for enabling their reliable use as forensic indicators (Amendt et al., 2010); however, the effect of suboptimal temperatures and their potential casework implications remain as relevant topics that deserve further investigation (López-García & Martín-Vega, 2025). The potential effect of other abiotic factors on insect biology is another aspect that needs further study in order to strengthen the reliability of the interpretation of entomological evidence in forensic investigations (Ferreira et al., 2025).

In recent decades, forensic entomology has embraced cutting-edge technologies and interdisciplinary approaches. DNA barcoding and similar molecular techniques allow rapid and precise identification of insect species (Durango-Manrique et al., 2025), which is essential for a reliable analysis and interpretation of entomological evidence. Nonetheless, morphological descriptions of the different life stages can also provide powerful tools for the unequivocal identification of forensically relevant species (Grella et al., 2025; Martínez-Sánchez et al., 2024). Additionally, advances in stable isotope analysis enable investigators to trace the geographic origin of insects (Owings et al., 2021), further narrowing the location of death or body transport. High-resolution imaging and AI also have enhanced the accuracy and efficiency of insect identification and life stage analysis (Gao et al., 2024). Innovative approaches exploring the applicability of state-of-the-art techniques provide novel insights into highly relevant topics in forensic entomology research, such as the post-feeding behaviour of necrophagous blow fly larvae (Mactaggart et al., 2025) or the age estimation of blow fly intra-puparial stages (Thümmel et al., 2025).

The integration of forensic entomology with other fields, such as forensic microbiology and environmental science, has opened new investigative avenues (Benbow & Pechal, 2019). For example, studies on the interaction between microbial communities and insect activity have improved PMI estimates (Benbow & Pechal, 2019). Remote sensing technologies, such as drones, are being explored for their potential to detect insect activity over large areas, especially in mass casualty events (Syed Mohd Daud et al., 2024). Furthermore, advancements in forensic entomology research not only benefit the investigation of suspicious human deaths, but also the investigation of abuse and neglect of vulnerable persons (Eremeeva et al., 2025), or wildlife poaching investigations (Pienaar & Dadour, 2025). The discipline has also expanded beyond postmortem interval estimation, to include applications such as detecting drug presence in tissues through analysis of insect larvae (Groth et al., 2024) and identifying locations of death based on insect species endemic to specific regions.

Despite certain limitations and challenges as highlighted above (Amendt et al., 2010; Wang et al., 2021), forensic entomology continues to evolve, driven by technological advancements and interdisciplinary collaboration. Its critical role in solving crimes and providing evidence underscores the importance of ongoing research and innovation in this field.

AUTHOR CONTRIBUTIONS

Zanthé Kotzé: Writing – original draft; writing – review and editing. **Daniel Martín-Vega:** Writing – original draft; writing – review and editing.

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