A Review of the Biological, Ecological, and Forensic Implications of the Mupli Beetle (*Luprops tristis*)

Dayana Sebastian*

Department of Digital Forensics, School of Sciences, Mallareddy University, Hyderabad, India

*Corresponding author: dayanaroy091@gmail.com

Abstract

Mupli beetle (*Luprops tristis*) is well known in seasonal mass indoor invasion in rubber-producing areas of India and is regarded as an important house pest. Although its biology, ecology, aggregation patterns and defensive chemistry have been well known, its possible significance to forensic science is not explored. This species, due to its close connection with human environments, seasonal predictability, and aggravating chemical excretions, could be of importance in areas of indoor crime scene entomology, medico-legal injury, environmental and public health forensic science, toxicology and civil litigation related to pests. This review is a synthesis of current biological and ecological data and an assessment of how these qualities can be applied to forensic value. The important knowledge gaps, such as the decomposition-stage association, the potential of the post-mortem interval estimate, the retention of chemical trace, and the microbial interactions are identified. Future direction of research suggested in the review is a way to establish whether Luprops tristis can be considered a forensically-relevant species in areas where this species is widespread.

Keywords: *Luprops tristis*; Mupli beetle; forensic entomology; indoor crime scene entomology; environmental forensics; medico-legal injury; dormancy; defensive secretion

1. Introduction

Forensic entomology is an important part of the modern forensic investigations through the interpretation of insect evidence in connection with the death scenes, environmental conditions, and medico-legal cases [1]. It is a critical area of forensic science that involves the application of insect biology in studies of the law that has been an important element of evidence in cases of death investigations, criminal cases and in civil court cases. The subdisciplines of the field are the medico-legal entomology, which addresses death

© The Author(s) 2026

D. R. Reddy et al. (eds.), *Proceedings of the First International Conference on Advances in Forensics and Cyber Technologies (ICFACT 2025)*, Advances in Computer Science Research 127,
https://doi.org/10.2991/978-94-6239-610-4_59

investigations, urban entomology, which addresses pest-related legal issues, and the stored-product entomology, which addresses insect contamination of commercial goods [2]. Most of these have been discussed in medico-legal entomology, due to its direct application in homicide cases and its capability of providing impartial evidence, the scientific aspect of which is beyond question in the criminal case.

The insects in the crime scenes and on the human remains can also be used by the forensic entomologists to date the death, calculate the postmortem movements of the body, and even supply information regarding the exposure to drugs or other toxins using entomotoxicological analysis [3] [4] **.**Specifically with regard to decomposing bodies, indoors, and deaths with delays in discovery, insects can present much valuable temporal and ecological data that is often not available using standard forensic pathology. Most of the practical aspects of forensic entomology remain largely dependent on few well-studied insect taxa, although its application is growing [5]

Due to the emergence of indoor murders, vacant homes, dead bodies in the shadows, build-up cultures, and pest-related civil conflicts, complex indoor ecological systems are becoming more of the focus of forensic investigations [6]. In most of these situations classical necrophagous insects can be missing, slow or unable to survive within an environment as a result of architectural obstructions, chemical or microclimatic conditions [7]. Nonetheless, such indoor spaces may be harbours of synanthropic or nuisance insects, which exhibit expected patterns of seasonal circulation, extended stay, aggregation, and recurring yearly infestations. Their inability to identify and analyze such insects in a forensic environment is a dire shortcoming, because the presence of important ecological and circumstantial evidence in terms of scene history, human presence and environmental continuity can be missed [8].

The existing forensic entomological paradigm mainly focuses on insects of the necrophagous type that directly infests the decomposing bodies [9]. In early decomposition Dipteran families such as Calliphoridae, Sarcophagidae, Muscidae and Phoridae dominate the postmortem interval estimations whereas Coleopteran families like Dermestidae, Silphidae, Staphylinidae, Cleridae and Histeridae do so in later stages. These insects are a reliable source of evidence, but the forensic utility of these insects is mostly confined to instances of exposed or accessible body parts. Thus, the insect evidence of the indoor settings, long-term residence, seasonal occupancy, and pest-related medico-legal complaints are not fully used [10]

The past researches have attempted to overcome the drawbacks of the conventional corpse-based entomology by diversifying the field of forensic research to the faunal succession models, area specific insect databases, indoor-outdoor comparative studies, and entomotoxicological studies using insect tissues as surrogate tissues [9] . The capabilities of estimating PMI using beetles, chemical analysis of insect secretions, and modelling of crime scenes ecology in the home environment have expanded the forensic scope in part [11], These attempts have however largely been restricted to insects that are already known to be involved in the process of decomposition leaving out ecologically dominant nuisance pests out of forensic scrutiny.

Current review suggests the conceptual expansion of forensic entomology based on the assessment of insect species, which, though not considered as being traditionally necrophagous, nevertheless possess close, predictable, and repeatable connections to human habitation. Luprops tristis, a seasonally invasive nuisance beetle, which is a widely studied organism in terms of its biology, ecology, dormancy behavior, and defensive chemistry, provides a novel model of such assessment. Current review examines the question: Can L. tristis serve as an indirect forensic indicator as a type of evidence in indoor entomology, environmental forensics, and medico-legal explanation of pest-related injuries? The hypothesis of the review is based on synthesizing the current ecological and biological knowledge and determining its applicability to the forensic scenario. The following review sections, the specifics of which are devoted to Luprops tristis, have the basis.

2. Postmortem Interval Estimation

The significance of the medico-legal entomology is related to the estimation of the postmortem interval (PMI), which is the interval between death and the crime scene detection, one of the most significant factors of the death investigation, as it may enable investigators to estimate the timeframes, verify the witnesses testimony, and relate suspects with crime scenes [2] [12] . Forensic entomology gives two complementary versions of PMI determination, each of which refers to a period of time and a background environment [2] [12]

First is premised on foreseeable developmental biology of insects which have a necrophilous lifestyle including the blowflies (Diptera: Calliphoridae), the larvae of which infest the carcass shortly after it has died. The age of the oldest maggots on the corpse and consideration of the environmental temperature allows the investigators to approximate a minimum postmortem interval (PMI min), which would suggest the latest possible initial date of death [2]**.** This method is most effective in the initial stages of decomposition when the primary colonizers are at maturity level which is normally within the first few days or weeks following death.

The second one uses the pattern of faunal succession- the pattern of insect succession colonizing and dominating decomposing remains over time. The insects have a relatively predictable distribution with respect to the ecology of the area, the season, and the location during the different stages of fresh, bloated, active decay, advanced decay and dry/skeletal decay [13]**.** One such example is beetles (Coleoptera), that in most circumstances are found at later levels of decomposition and contributes to the entomological PMI estimates by months or even years during which an organism has been dead, particularly in scenarios where the initial colonizers have developed or are absent due to environmental constraints [2] [14]

3. Crime Scene Insects as Biological Recorders

Crime scene insects are also biological recorders because they are the insects that acquire and store information on how death takes place. The crime scene insects are also used to determine evidence of corpse movement, season of the year, and exposure to the chemicals that would otherwise be not detectable using traditional forensic pathology, in addition to estimating PMI [3] [15]**.** The insect species, as well as the life cycle of the insects located on a scene point to the environmental conditions and the habitat where colonization occurred. Indicatively, the occurrence of the species that belong to the indoor environment on the remains, found in the outdoor environment, and vice versa, may suggest the postmortem mobility of the body [2].

Surrogate samples that can also be used to carry out toxicology research are insects; in cases where human tissues are fatigued, missing, or inadequate to carry out the tests [3] . This has also been applied in entomotoxicology, particularly in the handling of drug overdoses, poisoning as well as in instances of prolonged decay whereby the toxicological samples are destroyed. Retrospective case series indicate the insects contribute to the forensically useful evidence in most cases of death case investigations conducted during warm months and day-sensitive PMI min estimates when specimens are collected and analyzed in a manner appropriate to other evidence sources in the short- and long-term [16]. The reliance of such evidence on proper collection instructions, chain-of-custody documentation, species identification and access to tested and region-specific development and successional reference data, however, is critical [4] **.**

4. Significance of New Species Determination in Forensic Entomology

The quality of the forensic entomological evidence is fully dependent on the proper attribution of the species and the availability of species-specific biological, ecological and chemical reference data. The rate of development, thermal sensitivity, succession relationships, habitat, and xenobiotic accumulation capabilities of each insect species necrophagus vary and are directly used to compute PMI and this interpretation of cases [4] [12] **.** False identifications or generalized information about the related species may result in serious inaccuracies of PMI estimates, thereby compromising the efforts of the criminal investigators and legal prosecution. Consequently, the evaluation and description of new or unrecognized species to be used in forensics are an immediate requirement of the field development.

Especially, beetles need to be examined in detail as they are the most common one in later stages of deterioration and find numerous forensic uses in the case of high PMI. Dermestidae, Cleridae, Silphidae, Histeridae, Staphylinidae, and Nitidulidae are some of the most diverse insect families that contain various types of important predators, scavengers, or consumers of the dried tissues during the later stages of advanced decay [14] and are classified as Coleoptera. Many beetle species are not well defined in forensic terms; although this limits their application in a casework, many species are common in the crime scene when compared to blowfly species, which are better characterized and prevalent in the first phases of decomposition. New beetle species entry into the forensic entomological toolbox should, however, be approached in a methodical and complex manner, which considers taxonomic identity, life cycle, ecological roles, chemical composition and identifying the practical use.

5. Biology and Ecology of the Mupli Beetle (*Luprops tristis*)

5.1. General Overview

Mupli beetle (Luprops tristis) is a notorious for its massive home invading nature, with numbers reaching millions per residential building [17] . In the past, Litter stands of rubber plantations were found to be the main breeding and feeding grounds of these beetles. Wilted tender leaves of rubber tree (Hevea brasiliensis) were their source of food. They run out of tropical Africa and Asia up to Papua New Guinea.

This is due to the fact that the nutritional value of the prematurely fallen rubber leaves and the life cycle of the beetle coincides with the leaf phenology of the rubber tree, hence resulting in very high populations in these regions [18] **.** They lead a life without being noticed under the litter of the rubber tree. Millions of adult beetles also cluster and aggregate neighbouring houses due to the onset of early summer rains [18]

The density of L. tristis population is very high in agricultural ecosystems, particularly in plantations, compared to forest ecosystems. This is because there is increased organic plant debris, more exposed microhabitats , and the number of natural predators is reduced [19]**.** These beetles are light-seeking, and hence they might find themselves in places of residence. Another typical place where natural beetle aggregation is observed is under boulders and pits in the rubber plantations. Research indicates that it is a detritivore which consumes numerous plant litter including jackfruit, cocoa, wild jack and Terminalia arjuna [20]**.** It is also common among Indian states such as Kerala, Tamil Nadu, Karnataka, Andhra Pradesh and Sikkim [20].

5.2. Morphology

Luprops tristis is a dark, elongated darkling beetle measuring about 10–20 mm. Its body has three parts, namely head, thorax and abdomen. The head is small and downward bent with compound eyes and segmented antennae. The thorax has six legs and hardened forewings (elytra), which have ridges and protect the hindwings. The abdomen is narrow and segmented, containing its internal organs. Although it can fly, the beetle mostly crawls over the ground [21].

5.3. Rubber Plantation Dependence

L. tristis is highly ecologically dependent on rubber plantation, in particular, Hevea brasiliensis leaf litter. It is discovered that the rubber litter layer is the habitat of pupa, larvae, and adults, which is why it is their main habitat [22] [23] [24] [25]**.** There are highly beneficial microclimatic and nutritional conditions due to the yearly leaf shedding and sprouting patterns and the continued presence of senescent leaf [25]

5.4. **Population Explosion and Seasonal Invasion indoor (Forensic Relevance).**

A strong and consistent pattern of seasonal mass invasion of luprops tristis in rubber plantation areas and residential buildings report cases of hundreds of thousands of infestations to several million cases of invading beetles as per the time of year [17]. The events of these invasions take place shortly after a first pre-monsoon or early monsoon rainfall and have a very predictable time schedule, thus being valuable ecological evidence in forensic analysis on the case of an indoor environment [17] [22].

The beetles are nocturnal and have high aggregations in houses, and stay longer in the houses in their dormant condition. Defensive secretions in accidental contacts usually cause irritation of the skin and ocular discomfort and this can bear medico-legal consequences in injury attribution or pest related complaints. The intensity, timing, and duration of such infestations give circumstantial data applicable in determining seasonal timing, historical indoor habitation and environmental continuity at the scene of the crime.

5.5 Cycle of Development and Temporal Predictability.

Luprops tristis has a tightly controlled life cycle in relation to the phenology of rubber plantations leading to extremely predictable population dynamics every year [18]. Although the detailed reproductive parameters are of interest mostly to the ecologists, the forensic implications of the parameter are the fixed seasons of appearance and disappearance of the species. Adults move in and out of the house after witnessing early rainy seasons and spend around 8-9 months in the house after which they go back to the plantation habitats. This extended indoor inanimate, regardless of the presence of carcass, makes L. tristis unique to classical forensic insects and a possible indicator of timing of the environment and not stage of decomposition. Such an annual regularity of this cycle enables researchers to conclude seasonal records and environmental circumstances even in the lack of the evidence of the necrophagous insects.

5.6 **Dormancy as a Forensic Chronology Indicator of a Scene.**

Luprops tristis is dormant, which is one of the most forensically relevant characteristics. After indoor invasion, the beetles are aggregated, inactive and stay inactive in buildings over a long period. This drying period is accompanied by the monsoon season and continues until when the rubber leaf fall and food supply are re-initiated [18]. Forensically, the existence of the dormant aggregations can be a sign of long-term inactivity indoors, lack of habitation or little human intervention. On the other hand, the lack of foreseen aggregations in high dormancy months can indicate recent human activities or pest control as well as changed occupancy trends. These observations may help reconstruct an indoor scene, especially when it comes to overgrown, abandoned, or fuzzy chronology of occupancy.

5.7. **Seasonal Migration and Behaviour- Indoor Aggregation**.

Luprospis tristis migration is an annual process that has a strict order with a connection to environmental responses like rainfall and the host plant phenology. The wave of migration of plantations into homes is rapid, usually within hours, which causes sudden and widespread furniture infestation [17]. This is not a random dispersal but is a coordinated, globally population behavioral event. The behavior of indoors is performed in two separate stages, the first one is active and is divided into nocturnal movement and attracted to artificial light and the second stage is deep dormancy characterized by heavy congestion in unsedimented structural spaces ceilings, attics, wall voids. These predictable patterns enable the species to act as an ecological indicator of how the season and access to the indoors as well as the stability of the surroundings should be, hence, enabling inclusion in the domain of indoor forensic entomology and environmental forensic analysis.

The beetles abandon shelters and target the plantations once the wet monsoon is over and fresh leaf shedding starts once again. The darkling beetles, such as Luprops tristis, are well known to enter the indoor environment, such as houses, warehouses, and food storage facilities, seeking shelter, which has become a severe frustrating problem [21]

Large scale, seasonal, indoor invasions take place soon after the occurrence of the first pre-monsoon rain. The beetles are also nocturnal and highly attracted to artificial light in the early stage where they then resettle to dark and secure indoor habitat. This as well is a planned migration, and not a dispersal incident [18].

Annual synchronized mass invasion of human residences more so in rubber plantation belts is one of the worst behavioural traits of L. tristis. These migrations are in the range of thousands to several million beetles per household with people being found occupying ceilings, corner of the walls, roofing structures, electrical fixtures, and open surfaces. Beetles often land on beds and domestic items and result in emotional and hygienic disturbances to house-holders [26]. The defense secretion is a nuisance particularly on accidental or unintentional handling or crushing although it is not a bite, it releases a irritating, burning, defensive secretion. The severity of the infestation usually compels the residents to use indoors insecticidal treatments to minimize the population size of beetles [27].

One characteristic of this invasion cycle is a recurring pattern of using the same residential buildings or other sheltered areas each year, e.g. crevices under boulders. The consistency indicates that there is some sort of recognition-establishing mechanism based on the potential of orientation cues and/or semiochemicals instead of mere chance [22].

On the first 20 days in the house, beetles exhibit Nocturnal activity, Strong attraction to light, creptation in cracks, ceiling, and gaps in the walls. Once this temporary period is over, people become deeply dormant, taking about nine months to distribute themselves in masses in areas like attics, tiled roofs and structural gaps. This behaviour categorically makes *L. tristis* a severe domestic nuisance pest, and not an agricultural pest [23].

The nuisance profile that is detailed in literature is similar; beetles infest the houses after it rains, crawling on living spaces, falling off ceilings, and form non-portable groups in sheltered buildings (such as thatched roof and wall niches). Although not harmful to the body, disturbance releases a pungent and phenolic secretion that makes people more uncomfortable and enhances the pest status of the species [24] **.** Invariably, the species has been characterized as a serious indoor pest because of long-term indoor activity, high aggregate size, and persistent existence during the dormancy. Although it does not directly attack crops and people, the burning secretion during crushing and the excessive amounts of it indoors characterize its significance as a pest [26].

5.8. Swarming and Clustering Behaviour

It is almost impossible to believe that the beetles display a mass aggregation in millions within residential buildings and under huge stones or boulders prior to the monsoon. The invasion itself is said to be very coordinated and predictable and is performed every year at the same time with the same timing and selection patterns of the shelter among generations [22]

One of the main points is that the new-generation beetles who have no prior knowledge regarding the shelters that were used by parent populations can find and occupy the same structures every year, despite the pesticide treatment. This implies that there are the characteristics of enduring chemical signals that direct shelter identification [22].

The migration is sudden and collective, and not gradual. The rest of the active adult population is wiped out of plantations and into houses virtually in unison and in response to wet climatic stimuli. When inside, the beetles create thick immobile groups in their approach to dormancy [24].

5.9. Chemical Composition and Defensive Glands

Darkling beetles such as *Luprops tristis* can produce defensive chemicals that are stored in special glands. In case of danger, these compounds are exuded and they usually have nasty smells or tastes that discourage predators. L. tristis also has been examined on its biological properties including antioxidant activity. The proposed research directions might involve further chemical profiling of L. tristis extracts with the help of chromatographic and spectroscopic methods, including GC-MS, HPLC, NMR, and mass spectrometry, to determine and measure bioactive compounds [21] [28]

The GC-HRMS analysis revealed the presence of nine predominant chemical constituents of quinones, phenolics, aldehydes, fatty acids, alkanes, and thiols. These are 2,3-dimethyl-1,4- benzoquinone, 2, 5- dimethylhydroquinone, 1, 3-dihydroxy- 2-methylbenzene, tetracosane, pentacosane, hexacosane, oleic acid, 7- hexadecenal and tert- hexadecanethiol. Benzoquinones and hydroquinones were prevailing, which are in accord with defensive chemistry in known in Tenebrionidae. These compounds are corrosive and likely cause the strong odor and irritant effects of the secretion which are caused by quinone-rich compounds [29].

L. tristis has two pairs of eversible defensive glands that are situated between the seventh and the eighth abdominal sternites and are a length of about 0.8-0.9 mm. The beetle discharges its secretion when threatened, by everting the glands, and propelling it out with the aid of the hind tarsi. This presents a major defense mechanism and is highly responsible in its nuisance attribute in indoor environments, where unintentional contact leads to the release of secretion [29].

The defensive secretion shows various biological actions. It induces human skin blistering reactions, which are an expected reaction in quinine chemistry. The secretion has been shown to have a high antimitotic activity in bioassays, where it causes chromosomal abnormalities in the form of sticky chromosomes, distorted metaphase positions and breaks in Allium cepa root meristems. It was also found to have antioxidant potential in DPPH, ABTS, FRAP, and H2O2 scavenging. Screenings of antibacterials indicated the inhibition of Staphylococcus aureus (11 mm) and Escherichia coli (9 mm) [29]

One of the major experimental parts tested the effect of defensive secretion on the behavior of predators. Experiments that tested the reactions of predators to beetles intact and those with the glands removed revealed that beetle secretion had a strong inhibitory effect on house geckos and huntsman spiders. Conversely, weaver ants equally fed on both types, which implies that they were not discouraged. The findings indicate that chemical defense has an important ecological role because it determines which predators are still relevant, which leads to the low predation pressure, and ensures survival of the beetle population [29]

The larvae have two pairs of defensive glands, which are found in sternites II and III. The glands of larvae are non-eversible and discharged through long narrow tubes it is unlike the adult case. On the outside, the glands look like two conical lateral swellings on the belly of the larva [30].

6. Current Forensic Status of the Mupli Beetle (*Luprops tristis*)

Although it has been extensively studied on biology, ecology, aggregation behavior, and defensive chemistry, as of today, Luprops tristis has no definite role in forensic entomology. Contrary to frequently recorded families of forensic beetles including Dermestidae, Silphidae and Staphylinidae, no published case reports, postmortem decomposition or deceased interval (PMI) studies have been done to include L. tristis. So far, no human or animal remains have been linked to the species in forensic case investigation and there is no corpse colonization and succession-stage specificity evidence.

Nevertheless, there are various features that imply forensic relevance. The species show seasonal indoor movement that can be predicted; long-term dormancy in human residential areas; defensive secretions that may induce irritation of the skin, and encroaches on areas of indoor forensic entomology, environmental forensics and medico-legal interpretation of injury. Its distribution in low-ventilated, untouched buildings and in deserted sites, and its high seasonality may provide indirect indications of the conditions in a scene or the habitation past. Thus, even though *Luprops tristis* is not considered one of the forensic indicator species, it is providing ecological and behavioral characteristics that can be a reason to consider the exploratory forensic assessment.

7. Proposed Future Forensic Pathways

In order to find out whether *Luprops tristis* can be used as a useful forensic species, specific research should be done in the following areas

7.1. Decomposition and PMI Association Studies

Controlled animal or cadaver decomposition studies are required to determine whether the species participates in or avoids remains, and if present, during which postmortem stage. The species' indoor aggregation tendencies make it especially relevant for studying indoor death contexts.

7.2. Behavioral and Successional Biology Under Forensic Conditions

The experiments that evaluate whether the beetle feeds on tissue, or associations with body fluids or microbial succession would aid in determining whether the beetle is a necrophagous, incidental or environmental species in the forensic list.

7.3. Chemical Trace Evidence Research

Defensive gland secretions should be tested in terms of persistence, detectability and chemical stability on textiles, skin, and interior surfaces to allow eventual use as trace-values in toxicology, chemical forensics and injury attribution.

7.4. Geospatial and Seasonal Forensic Profiling

As it bears close relation to rubber plantation ecosystems, mapping its distribution can assist in areas of environmental forensics, crime scene localization and ecosystem based investigative profiling

7.5. Indoor Crime Scene Ecology Modeling

The clustering tendencies of the species, length of dormancy, and cycles of population can appeal to the design of entomology models that can be used to forecast the time of non-occupancy, neglect of property, or history of scene access

8. Conclusion

Even though Luprops tristis remains the only type of pest that is currently categorized as a nuisance pest (with no involvement in forensic casework) due to its seasonal abundance, long-term indoor presence, and medically significant defensive behaviour, it has emerged as a candidate to be incorporated in future forensic investigations due to its distinctive combination of characteristics. Species predictable ecological cycle, high habitat selectivity, and relationships with manmade structures are consistent with emerging subdivisions of the field of forensic science, specifically, indoor entomology and environmental forensic utilization.

Since there is no available literature on forensic studies, this review forms the original scientific background in the assessment of the forensic potential of Luprops tristis. Experimental, ecological, and case-based studies should be conducted in the future to ascertain whether this species can, in the future, be accepted as a forensic indicator, either as a time-related marker, trace chemical source, environmental bioindicator, or incidental indoor forensic insect. Since forensic entomology is increasingly developing beyond the necrophagous species, Luprops tristis is an area of new and field-wide research.

References

1. Kenawy, M., & Abdel-Hamid, Y. (2019). *Medico-legal forensic entomology: Use of insects in death investigations – A review*. Egyptian Academic Journal of Biological Sciences, E. Medical Entomology & Parasitology, 11(2), 59–74. https://doi.org/10.21608/eajbse.2019.61865
2. Abbasi, E. (2025). *Forensic entomology in criminal investigations*. American Journal of Forensic Medicine & Pathology, 46(4), 298–306. https://doi.org/10.1097/PAF.0000000000001067
3. Bansode, S., Morajkar, A., Ragade, V., More, V., & Kharat, K. (2025). *Challenges and considerations in forensic entomology: A comprehensive review*. Journal of Forensic and Legal Medicine, 110, 102831. https://doi.org/10.1016/j.jflm.2025.102831
4. Mashaly, A., Ibrahim, A., Mashaly, A., & Ibrahim, A. (2022). *Forensic entomology research in Egypt: A review article*. Egyptian Journal of Forensic Sciences, 12(1). https://doi.org/10.1186/s41935-022-00272-8
5. Matuszewski, S., & Mądra-Bielewicz, A. (2019). *Post-mortem interval estimation based on insect evidence in a quasi-indoor habitat*. Science & Justice, 59(2), 109–115. https://doi.org/10.1016/j.scijus.2018.06.004
6. Reibe, S., & Madea, B. (2010). *How promptly do blowflies colonise fresh carcasses? A study comparing indoor and outdoor locations*. Forensic Science International, 195(1–3), 52–57.
7. Campobasso, C. P., Di Vella, G., & Introna, F. (2001). *Factors affecting decomposition and Diptera colonization*. Forensic Science International, 120(1–2), 18–27.

8. Tomberlin, J. K., & Benbow, M. E. (2015). *Forensic entomology: International dimensions and frontiers*. CRC Press.
9. Amendt, J., Richards, C. S., Campobasso, C. P., Zehner, R., & Hall, M. J. R. (2011). *Forensic entomology: Applications and limitations*. Forensic Science, Medicine and Pathology, 7(4), 379–392. https://doi.org/10.1007/s12024-010-9209-z
10. Byrd, J. H., & Castner, J. L. (Eds.). (2010). *Forensic entomology: The utility of arthropods in legal investigations* (2nd ed.). CRC Press.
11. Mądra-Bielewicz, A., & Matuszewski, S. (2020). *A general approach for postmortem interval based on uniformly distributed and interconnected qualitative indicators*. International Journal of Legal Medicine, 131(3), 877–884.
12. Pérez-Villegas, M., & Martínez-Falcón, A. P. (2025). *Entomología forense: Los insectos como detectives en la escena del crimen*. Herreriana, 7(1), 15–20. https://doi.org/10.29057/h.v7i1.12466
13. Scanvion, Q., Hédouin, V., & Charabidzé, D. (2018). *Collective exodigestion favours blow fly colonization and development on fresh carcasses*. Animal Behaviour, 141, 221–232. https://doi.org/10.1016/j.anbehav.2018.05.01
14. Aballay, F. A., Flores, G. E., Silvestro, V. A., Zanetti, N. I., & Centeno, N. D. (2016). *An illustrated key to, and diagnoses of the species of Tenebrionidae (Coleoptera) associated with decaying carcasses in Argentina*. Annales Zoologici, 66(4), 703–726. https://doi.org/10.3161/00034541anz2016.66.4.021
15. Rai, J. K., Pickles, B. J., & Perotti, M. A. (2021). *The impact of the decomposition process of shallow graves on soil mite abundance*. Journal of Forensic Sciences, 67(2), 605–618. https://doi.org/10.1111/1556-4029.14906
16. Pittner, S., Bugelli, V., Weitgasser, K., Zissler, A., Sanit, S., Lutz, L., Monticelli, F., Campobasso, C. P., Steinbacher, P., & Amendt, J. (2020). *A field study to evaluate PMI estimation methods for advanced decomposition stages*. International Journal of Legal Medicine, 134(4), 1361–1373. https://doi.org/10.1007/s00414-020-02278-0
17. Aswathi, P. (2020). *Host plants of the home invading nuisance pest, Luprops tristis…*. Entomon, 45(1), 31–42.
18. Sabu, T. K., Vinod, K. V., Jobi, M. J., & George, S. (2010). *Life history, aggregation and dormancy of the rubber plantation litter beetle Luprops tristis…*. Journal of Insect Science, 10(1), 1–11. https://doi.org/10.1673/031.010.0101
19. Arunraj, C., Vineesh, J. P., & Sabu, T. K. (2017). *Darkling beetles of forest sites and agricultural fields…*. Journal of Insect Biodiversity, 5(3), 1–12.
20. Aswathi, P., & Sabu, T. K. (2021). *Luprops beetle: How a detritivorous litter dwelling beetle becomes a nuisance…*.
21. Syamjith, P., Shijin, M. S., Jyothi, E. T., & Babu, G. (2024). *Pros and cons of Luprops tristis – A review*. International Journal of Pharmaceutical Sciences, 2(5), 254–267. https://doi.org/10.5281/zenodo.11127425
22. Nirdev, P. M., & Thomas, S. K. (2015). *Semiochemicals in the defensive gland secretion…*. HEXAPODA, 25–30.
23. Vinod, K. V., & Sabu, T. K. (2010). *Dormancy-inducing factors of Luprops tristis*. Insect Science, 17(1), 47–51.
24. Sabu, T. K., & Vinod, K. V. (2009). *Food preferences of the rubber plantation litter beetle, Luprops tristis*. Journal of Insect Science, 9(1), 72.
25. Sabu, T. K., Vinod, K. V., & Meehan, T. (2009). *Population dynamics of Luprops tristis…*. Journal of Insect Science, 9(1).
26. Aswathi, P., Sruthi, K. S., & Thomas, S. K. (2013). *Fate of the home invader nuisance beetle…*. HEXAPODA, 89–93.

27. Aswathi, P., & Sabu, T. K. (2011). *Weaver ant, huntsman spider and house gecko as biocontrol agents…*. Halteres, 3(3), 56–61.
28. Aswathi, P., Jobi, M. C., & Thomas, S. K. (2012). *Biocontrol of home invading rubber litter beetle…*. Journal of Biopesticides, 5.
29. Sabira, O., Vignesh, A. R., Ajaykumar, A. P., Varma, S. R., Jayaraj, K. N., Sebastin, M., … Sujith, M. S. (2022). *Chemical composition and biological properties of the defensive gland extract…*. Molecules, 27(21), 7476.
30. Abhitha, P., Vinod, K. V., & Sabu, T. K. (2010). *Defensive glands in the adult and larval stages of Luprops tristis*. Journal of Insect Science, 10(1), 7.
31. Mohammed, S., Hesselberg, T., & Rafeeq, K. U. M. A. (2024). *Occurrence of indoor insect pests and illnesses…*. Oriental Insects, 58(1), 22–36. https://doi.org/10.1080/00305316.2023.2217179
32. Binsha, P., & Thomas, S. K. (2022). *Control of Luprops tristis during its dormancy with insect growth regulators*. Indian Journal of Entomology, 156–159.
33. Harvey, M., Gasz, N., & Voss, S. (2016). *Entomology-based methods for estimation of postmortem interval*. Research and Reports in Forensic Medical Science, 1.
34. Applications of forensic entomology: overview and update. (2020). *Archiwum Medycyny Sądowej i Kryminologii*.
35. Merkl, O., Sabu, T. K., & Abitha, P. (2007). *A new Luprops species…*. Zootaxa, 1636, 47–58. https://doi.org/10.5281/zenodo.179547
36. Nirdev, P. M., Jobi, M. C., & Thomas, S. K. (2011). *Predator reluctance of weaver ants with Luprops as prey*. Journal of Biopesticides, 4(2), 106.
37. Sanyanga, T. (2016). *Entomological examination of the relationship between ante-mortem and post-mortem amitriptyline concentrations in insects*. Belarusian State Pedagogical University Repository.
38. Tom, H., & Kaippallil, J. D. (2016). *A preliminary study on the diversity of coleopterans…*. Journal of Entomology and Zoology Studies, 4(5), 297–300.
39. Vineesh, P. J., Mathew, A., Kavyamol, P. M., Vineetha, V. P., Rajagopal, R., Alfarhan, A., … Ramesh, V. (2023). *Essential oils of cinnamon, turmeric and neem as potential control agents…*. Journal of King Saud University–Science, 35(1), 102363.
40. Western Ghats NPPR. (2014). *Antibacterial potential of Luprops tristis…*.
41. Asha Raju, R., & Radhika, R. (2023). *Review study on a home invading pest Mupli beetle (Luprops tristis)*. Uttar Pradesh Journal of Zoology, 44(16), 107–114. https://doi.org/10.56557/upjoz/2023/v44i163584
42. Surapaneni, V. A., Bold, G., Speck, T., & Thielen, M. (n.d.). *Review history*. (Incomplete reference—details unavailable.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.