# Role of entomological evidence in criminal investigations

**Serhii Rozumnyi * [a], Daria Mylostyva ** [b], Svitlana Poliakova *** [c], Anna Babchenko **** [d]**

* Scientific Research Institute of Forensic Sciences, Dnipropetrovsk, Dnipro, Ukraine, ORCID: https://orcid.org/0009-0002-0711-1443
** PhD in Agriculture, Scientific Research Institute of Forensic Sciences, Dnipropetrovsk, Dnipro, Ukraine, ORCID: https://orcid.org/0000-0002-3609-776x, e-mail: mylostivad@i.ua
*** PhD in Philology, Scientific Research Institute of Forensic Sciences, Dnipropetrovsk, Dnipro, Ukraine, ORCID: https://orcid.org/0009-0000-1088-7782, e-mail: polyana729@ukr.net
**** PhD in Biology, Scientific Research Institute of Forensic Sciences, Dnipropetrovsk, Dnipro, Ukraine, ORCID: https://orcid.org/0000-0002-3491-931X, e-mail: lineaanna83@gmail.com

[a] Project Administration.
[b] Writing – original draft, Methodology, Supervision, Formal analysis, Resources, Software.
[c] Project administration, Supervision, Formal analysis.
[d] Methodology, Supervision, Formal analysis, Resources, Software.

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*Domestic and foreign literary sources on the use of necrotic fauna in forensics are analyzed. The purpose of this article is to emphasize the importance of necrotic fauna research for practical forensics and highlight the influence of necrotic entomophiles on the time of death of a living object (depending on its species and environmental conditions) which biological and general scientific methods are applied for. A comparative analysis of the activity of necrotic fauna representatives is given. The need to use necrofauna in the systematic work of forensic biologists has been updated. The main application of forensic entomology as a branch of applied entomology is*

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*the study of the faunal complex of necrobiont arthropods on a discovered corpse to meet the needs of the investigation and the court. Entomological knowledge makes it possible to successfully perform classification, identification and diagnostic tasks that appear in forensic expert practice. Since the processes of corpse decay and the types of necrotic insects on it differ depending on the type of corpse and the type of biogeocenosis where this corpse was located, each of these features affects further forensic investigations. Obtained entomological data are a reliable source of information for finding out objective truth during pre-trial investigation and subsequent legal proceedings. At the same time, determining the time of death by cadaveric fauna can have only auxiliary value, since the appearance and development of insects is very variable. Prospects for further research are formulated, including improvement of entomological research methods (in particular, in different environmental conditions), the need for development of forensic biology as an integral component of forensic science is proven.*

***Keywords:*** *necrofauna; entomology; criminalistics; corpse; living object.*

## Research Problem Formulation

One of important and often difficult issue during investigation of criminal cases in the case of death under non-obvious circumstances of finding out the time limit for the death of a living object. The late discovery of a corpse caused by attempts to hide a crime, discovery in closed rooms or a sparsely populated area, and putrefactive changes in the body make especially difficult to determine the death age.

Traditionally, the issue death prescription is solved during the conduct of either a forensic medical examination of a corpse (person), or a forensic biological or veterinary examination (other living objects). In the late postmortem period (more than 72 hours), determining the prescription of death for a forensic expert becomes a rather difficult task. Most of classical methods of forensic research in such cases become inaccurate, the date of death is determined by forensic expert mostly subjectively on macroscopic grounds, based on the gained experience of expert work. The expert's conclusions are probabilistic in nature, and the established interval of prescription of death can vary from several days to several months, which greatly complicates the work of investigative bodies to solve crimes [1].

Life cycle of insects has its differences according to the seasons of the year, which makes it possible not only to determine the postmortem time, but even the year of the death of living object. Each environment where the corpse is located is characterized by its own necrotic fauna. Cycles of development of necrotic insects, changing according to environmental conditions,

1 Malainey S. L., Anderson G. S. Impact of confinement in vehicle trunks on decomposition and entomological colonization of carcasses. *PLOS One*. 2020. Apr 15. 0231207. DOI: 10.1371/journal.pone.0231207 (date accessed: 27.05.2024).

make possible to determine the main issue related to the time of death.

## Analysis of Essential Researches and Publications

In legal medicine, cadaveric phenomena are divided into abiotic phenomena that occur after the end of life (negative markers) and transformational phenomena that occur over time and cause significant changes in the morphology and structure of the corpse (positive markers). Abiotic phenomena can be immediate, i.e., appear immediately after the heart, lungs and brain stop vital activity (loss of consciousness, sensitivity, movement, muscle tone, lack of breathing and blood circulation). They can be indirect, i.e., appear sometimes after death, the end of vital activity (cooling of the body, swelling, darkening, dehydration and acidification). Transformational phenomena can be destructive, causing the decay of organic substances (autolysis, self-digestion, and putrefaction), or conservative, i.e., those that cause abnormal transformation of a corpse depending on various environmental conditions (maceration in submerged bodies, mummification in a dry environment) [2].

Currently, role of forensic entomology in forensic research is insignificant. First of all, this is due to the lack of qualified forensic entomologists and insufficient development of forensic-entomological research methods. Entomofauna of corpses can be very diverse and numerous, containing many species at different life stages. Although there can be a significant number of entomofauna representatives on the corpse, only a small part of it is needed to assess postmortem period.

Forensic entomology has gained the greatest development in the USA, where practical guidance on forensic entomological expertise has been successfully operating for quite some time. In Ukraine, so far, this direction is being developed only at National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute» of the Ministry of Justice of Ukraine. Although at different times such specialists as V. Kononenko and M. Marchenko [3] were interested in the question of the role of necrotic fauna, citing scientific data on the entomofauna of the corpse, expert research of the crime scene, research on the content of necrotic insects. V. Olkhovskyi, L. Holubovych and M. Tahaiev with their co-authors [4] carefully analyzed the available scientific literature and practical recommendations, as well as their own achievements in determining the time of death. A. Prokopenko [5] presents a comparative analysis of various necrofauna

2 Hofer I. M. J., Hart A. J., Martín-Vega D., Hall M. J. R. Estimating crime scene temperatures from nearby meteorological station data. *Forensic Science International.* 2020. Vol. 306. Art. 110028. DOI: 10.1016/j.forsciint.2019.110028 (date accessed: 27.05.2024).

3 Марченко М. И., Кононенко В. И. Практическое руководство по судебной энтомологии / под ред. А. Ф. Рубежанского. Харьков, 1991. 69 с.

4 Ольховський В. О., Голубович Л. Л., Тагаєв М. М., Хижняк В. В., Голубович П. Л., Кравченко Ю. М., Голубович А. Л., Балановський В. В., Моргун А. О., Коновал Н. С. Визначення давності настання смерті : монографія / за заг. ред. В. О. Ольховського та Л. Л. Голубовича. Харків, 2017. 168 с.

5 Прокопенко А. А. Сукцессионные изменения энтомофауны трупа и использование их в судебно-экспертной практике. *Известия Харьковского энтомологического общества*. 2000. Т. 8. Вып. 2. С. 89—90. URL: https://repo.btu.kharkov.ua//handle/123456789/21188 (date accessed: 27.05.2024).

on corpses, in the works of M. Shulman[6], successional changes in the process of destruction of zoogenic waste are outlined and trophic specialization of the main groups of insects of the necrophilous complex is characterized, regularities of the processes of decomposition and utilization of various animal corpses are determined, changes occurring in entomonecrophilic complex in urban ecosystems.

## Article Purpose

Emphasize importance of necrotic fauna research for practical criminalistics and highlight the impact of necrotic entomophiles on the time of death of living object (depending on its type and environmental conditions).

## Research Methods

In order to determine the role of entomological evidence in forensic examinations, biological and general scientific research methods were used to study necrophilic fauna.

## Main Content Presentation

There are two main approaches to defining postmortem interval using insects as physical evidence. The first is based on the study of the successive colonization of the corpse by insects (succession), the second is based on the development of flies that colonize the corpse shortly after death. Succession data (first approach) are suitable for use from one month to one year after death or complete skeletonization of the corpse, and the second approach is up to one month after death, very rarely longer than a month [7].

Upon appointment of investigator or a court, forensic biologist shall determine, in particular:

- prescription of death;
- time of year of death;
- types of necrophilic insects found on the corpse;
- age of settlement of the corpse by necrophilic insects;
- prescription of death (taking into account the interval of settlement of the corpse by necrophilic insects);
- fact of moving the corpse;
- place of initial residence of the corpse or the place of concealment of the corpse;
- degree of decomposition of corpse in a particular place for a known period of time (simulation method);
- availability in larvae of insects of toxins and/or drugs that caused the death of a person (in case of detection of skeletal corpses).

Thus, it can be stated that forensic entomology is a rather important field of forensic science that contributes to investigation or court to reach right conclusions [8].

6 Шульман М. В. Домінантні групи безхребетних тварин в утилізаційних процесах мертвої органіки. *Науковий вісник Чернівецького університету. Серія: Біологія.* 2008. Вип. 373. С. 217—221.

7 Benecke M. A brief history of forensic entomology. *Forensic Science International.* 2001. Vol. 120. Is. 1—2. Pp. 2—14. DOI: 10.1016/S0379-0738(01)00409-1 (date accessed: 27.05.2024) ; Richards C. S., Paterson I. D., Villet M. H. Estimating the age of immature *Chrysomya albiceps* (Diptera: Calliphoridae), correcting for temperature and geographical latitude. *International Journal of Legal Medicine.* 2008. Vol. 122. Pp. 271—279. DOI: 10.1007/s00414-007-0201-7 (date accessed: 27.05.2024).

8 Ольховський В. О., Голубович Л. Л., Тагаєв М. М., Хижняк В. В., Голубович П. Л., Кравченко Ю. М., Голубович А. Л., Балановський В. В., Моргун А. О., Коновал Н. С. Зазнач. твір.

For individual representatives of the necrotic fauna, a forensic biologist can almost immediately determine the approximate time of death. For example, the so-called dead fly: *Cynomya mortuorum* (*Linnaeus*, 1761), which is one of the most common species in the family of meat flies *Calliphoridae*. *Calliphoridae* flies are the most numerous group of necrophages from the entire block of necrotic entomofauna. Diptera of the *families Sarcophagidae, Muscidae* and *Piophilidae* and solid wings of the families *Silphidae*, *Trogidae* and *Dermestidae* are typical necrophages. Another important group of the necrotic entomocomplex are parasitic insects and predators of necrophagous insects. First of all, these are beetles *of* the *Staphylinidae* and *Histeridae* families: the main consumers of fly larvae.

In case of research on a rottenly altered corpse (person or other living object), the question of the time of death acutely arises, to which the forensic medical expert has to answer. Determining the time of death on the basis of a complex of macroscopic signs, assessed visually, is quite subjective, in addition, the interval of death that is determined, can vary from several days to several months [9]. Currently, there are not many instrumental biophysical diagnostic methods that can be used in the late postmortem period.

One of these methods is entomological research. This technique was used as early as the second half of the 19th century, when they noticed the regularity of changes in different types of insects at certain stages of body decomposition. For example, larvae of flies and beetles give way to larvae of lepidopterans. In the summer, the development cycle of a housefly (3 weeks on average) is used for this. availability of only fly eggs on the corpse indicates that the time of death is within 24 hours, and the presence of eggs and larvae is more than one day. A significant number of larvae indicates that death occurred a week ago, and appearance of pupae more than a week ago. It should be borne in mind that the gray flesh fly (*Sarcophagidae*) immediately lays larvae, which during the first day, depending on weather conditions, become 2-3 mm long, sometimes more. At the same time, determining the time of death by cadaveric fauna can have only auxiliary value, since the appearance and development of insects is very variable. In the context of the forensic-biological examination of necrofauna, the corpse should be considered precisely as an ecosystem capable of self-regulation of the processes taking place in it. This dynamic system is characterized by the variability of interacting populations and self-reorganization depending on life cycles [10].

The system depends on the specific environmental conditions (temperature, humidity, season, weather conditions, specific biotope), the features of the corpse (constitution, clothing material, contamination with fuel, lubricant and paint and varnish substances, tissue burning, the presence of tight skin and wool on animal corpses and scales on fish), genotypic and phenotypic

9 Марченко М. И., Кононенко В. И. Указ. соч. ; Прокопенко А. А. Сукцессионные изменения … . URL: https://repo.btu.kharkov.ua//handle/123456789/21188 (date accessed: 27.05.2024).

10 Grassberger M., Frank C. Initial study of arthropod succession on pig carrion in a Central European urban habitat. *Journal of Medical Entomology.* 2004. Vol. 41. Is. 3. Pp. 511—523. DOI: 10.1603/0022-2585-41.3.511 (date accessed: 27.05.2024) ; Ольховський В. О., Голубович Л. Л., Тагаєв М. М., Хижняк В. В., Голубович П. Л., Кравченко Ю. М., Голубович А. Л., Балановський В. В., Моргун А. О., Коновал Н. С. Зазнач. твір.

heterogeneity of populations and interaction between them. In living conditions, entomofauna has its own specifics. It is due to a certain stability of the microclimate, the ways of penetration into the room of necrophages and the presence of synanthropic insects[11]. The fastest decomposition rate was recorded in rural areas, and the slowest in mountainous areas[12].

All arthropods involved in the decomposition of the corpse can be divided into 3 ecological groups:

1) obligate necrobionts are insects that specialize exclusively in cadaveric tissues and by determining the age of which they usually determine the prescription of death (obligate necrophages and kératophages: a squad of flies *(Diptera0*, mainly represented by the families of the fallen flies (*Calliphoridae*), gray meat flies (*Sarcophagidae*), cheese flies (*Piophilidae*); a squad of *Coleoptera*, represented by the families of dead wings (*Sliphidae*) and skin beetles (*Dermestidae*));
2) facultative necrobionts are not as common as representatives of the first group. Numerous populations of these necrophilic insects are able to influence cadaveric decomposition by competing with obligate necrophages. The diet of this class of necrofauna is quite diverse, these include facultative necrophages (polyphages), entomophages (zoophages), saprophages (in particular, coprophages) and parasites. This group is represented by various taxonomic units of ants (*Formicidae*), wasps, beetles, cockroaches (*Blattodea*), some flies, as well as membranes parasitic on immature fly larvae. This group includes the families of mites*: Macrochelidae, Parasitidae, Parholaspidididae and Urodidae*, which hunt other insects and even nematodes;
3) random necrobionts that use decomposable remains as a normal environment. They are represented by polyphages, saprophages and mycetophages; these include leg-tails (*Collembola*), a variety of spiders, lipopods *(Chilopoda*), woodlice *(Armadillidiidae*) and some ticks.

Blow flies (commonly known as flies) play an important role in the process of decomposition of animals in most terrestrial ecosystems. Because they are often the first to appear and lay eggs on the cadaver, the oldest blow flies collected on the cadaver is often used to obtain the minimum post-mortem interval for dealing with death cases [13]. Meat flies are ectothermic animals, and the time of their development depends on the species. Thus it is important to accurately identify the species of meat flies and reconstruct the temperature profiles of the scene in order to correctly estimate the minimum post-mortem interval [14].

A dead body, hidden or in a confined space, can become an obstacle to primary

11 Bygarski K., LeBlanc H. N. Decomposition and Arthropod Succession in Whitehorse, Yukon Territory, Canada. *Journal of Forensic Science*. 2013. Vol. 58. Is. 2. Pp. 413—418. DOI: 10.1111/1556-4029.12032 (date accessed: 27.05.2024) ; Denno R. F., Cothran W. R. Competitive Interactions and Ecological Strategies of Sarcophagid and Calliphorid Flies Inhabiting Rabbit Carrion. *Annals of the Entomological Society of America*. 1976. Vol. 69. Is. 1. Pp. 109—113.

12 Шульман М. В. Зазнач. твір.

13 Amendt J., Richards C. S., Campobasso C. P., Zehner R., Hall M. J. R. Forensic entomology: applications and limitations. *Forensic Science, Medicine, and Pathology.* 2011. Vol. 7. Is. 4. Pp. 379—392. DOI: 10.1007/s12024-010-9209-2 (date accessed: 27.05.2024).

14 Denno R. F., Cothran W. R. Op. cit.

colonization by Calliphoridae. Field tests of pork carcasses hidden in the trunks of cars showed a delay in colonization by 3-6 days [15]. Another experiment simulated the effect of solar radiation on the temperature difference inside the car compartment compared to the outside environment. This research indicated that even taking into account the color of the vehicle, the temperature in the airtight cabin can significantly exceed the ambient temperature [16].

The ratio of pupae and adult flies remaining inside the vehicle led to the conclusion that adult flies were probably unable to leave the confined space. Consequently, the research indicated that adult flies can find themselves locked in a high-temperature zone. In this same study, it was observed that accelerated decomposition is catalyzed by higher temperatures inside cars (compared to ambient temperatures).

Another important species of flies for forensic examination that lives in a number of countries of the Asian continent is *Chrysomya pinguis*. Existence of life cycle stages (egg, larva, pupa or adult) of this fly among corpses and/or places of death of people increases sharply in the habitats of this species, and therefore they can be used as entomological evidence for forensic medical research. For example, in Korea, collected from the corpse of *Ch. pinguis* was used to confirm that a man died 10 days before the discovery of his corpse, indicating the importance of using *Ch. pinguis* in forensic researches [17].

Entomological researches on species of flies important for forensic examination proved that *Ch. pinguis* predominates in highland areas of mixed deciduous forests, similar to *Chrysomya thanomthini*, *Hypopygiopsis tumrasvini*, *Lucilia papuensis* and *Lucilia Porphyrina* [18].

*L. Porphyrina* species colonizes human corpses and lives most often in forested areas, adults are attracted to decomposing animal substances, and larvae are scavengers [19].

Separate researches on pig carcasses revealed that the greatest activity of flies larvae, which destroy most organic tissues, was registered during the first 7-30 days after death. In the fresh stage (first 24 hours), when the remains are odorless, the eggs of *Lucilia illustris* (*Meigen, 1826*) (*Calliphoridae*) are laid first, followed by *Phormia regina* (*Meigen, 1826*) (*Calliphoridae*). An increase in the internal

15 Malainey S. L., Anderson G. S. Op. cit. DOI: 10.1371/journal.pone.0231207 (date accessed: 27.05.2024).

16 Dadour I. R., Almanjahie I., Fowkes N. D., Keady G., Vijayan K. Temperature variations in a parked vehicle. *Forensic Science International.* 2011. Vol. 207. Is. 1—3. Pp. 205—211. DOI: 10.1016/j.forsciint.2010.10.009 (date accessed: 27.05.2024).

17 Silahuddin S. A., Latif B., Kurahashi H., Walter D. E., Heo Ch. Ch. The Importance of Habitat in the Ecology of Decomposition on Rabbit Carcasses in Malaysia: Implications in Forensic Entomology. *Journal of Medical Entomology*. 2015. Vol. 52. Is. 1. Pp. 9—23. DOI: 10.1093/jme/tju001 (date accessed: 27.05.2024).

18 Moophayak K., Klong-Klaew T., Sukontason K., Kurahashi H., Tomberlin J. K., Sukontason K. L. Species composition of carrion blow flies in northern Thailand: altitude appraisal. *Revista do Instituto de Medicina Tropical de São Paulo*. 2014. Vol. 56. Is. 2. Pp. 179—182. DOI: 10.1590/S0036-46652014000200016 (date accessed: 27.05.2024) ; Щербаковський М. Г. Судова експертологія : навч. посіб. Харків, 2008. 198 с. URL: https://dspace.univd.edu.ua/server/api/core/bitstreams/f68ffa51-4fe1-4991-bcee-7a5a8627e0d8/content (date accessed: 27.05.2024).

19 Kurahashi H., Chowanadisai L. Blow flies (Insecta : Diptera : Calliphoridae) from Indochina. *Species Diversity*. 2001. Vol. 6. Is. 3. Pp. 185—242. DOI: 10.12782/specdiv.6.185 (date accessed: 27.05.2024).

temperature of the carcass was recorded as the mass of the larvae developed, starting from the swelling stage (2—10 days). This stage was characterized by a change in color, as well as the appearance of marbling, bloating or edema. At the stage of active decomposition (11—16 days), a strong smell of decay accompanied the thinning of tissues, and the feeding of the larvae caused a rupture of the skin; at this stage the temperature reached its maximum. At an advanced stage of decomposition (17—42 days), the larvae began to leave the carrion in search of a suitable place for pupation. And 51 days later, the skeletonization of the remains was almost complete — bones, cartilage and some tissue remnants remained, amounting to approximately 25% of the initial weight. This stage was characterized by a noticeable decrease in larval activity and a slight odor from the remains or its absence. Insect activity completely stopped in 271 days [20].

*J. Amendt* with co-authors notes that samples from the place of death should accurately reflect the entomofauna of the corpse, that is, the sample should represent all life stages of each important species of insects inhabiting the corpse [21]. This is confirmed by *Sz. Matuszewski*, noting the need to take into account peculiarities of collecting necrophilic insects [22]. In a fairly fresh corpse, eggs or larvae of flies on natural anatomical openings (especially the head) or wounds mostly prevail; at the initial signs of decomposition, fly larvae are found in natural openings of the body, in wounds on the border between the corpse and the ground; during active decomposition (exudation of corpse fluid, obvious smell of decay), larvae of flies and beetles live on the body, which are found on the clothes and surface of the corpse, the soil near the corpse (in case of death in an open space) or the floor of the room (in case of death in the premises) ; in the deeper stages of decomposition (darkening of the remains of the skin, bones), puparia of flies (full and empty), larvae and pupae of beetles, larvae of flies that settle in the late stages of decomposition, on the soil near the corpse (in case of death in open space), on the floor, under carpets or furniture (indoors), in the pockets and folds of the corpse clothes.

Most often, forensic entomologists estimate the age of sexually mature insects collected at the site of death and use this information as the minimum postmortem period [23]. For such an assessment, it is necessary to compare the reference data on the development of a particular species with the results obtained from the insect corpse collected at the site of detection. Because developmental data may vary by geographic insect population, it is recommended to use reference data on insect populations in a specific geographic region [24].

20 Campobasso C. P., Di Vella G., Introna F. Factors affecting decomposition and Diptera colonization. *Forensic Science International.* 2001. Vol. 120. Is. 1—2. Pp. 18—27. DOI: 10.1016/s0379-0738(01)00411-x (date accessed: 27.05.2024).

21 Amendt J., Richards C. S., Campobasso C. P., Zehner R., Hall M. J. R. Op. cit. DOI: 10.1007/s12024-010-9209-2 (date accessed: 27.05.2024).

22 Matuszewski Sz. Post-Mortem Interval Estimation Based on Insect Evidence: Current Challenges. *Insects*. 2021. Vol. 12. Is. 4. Art. 314. DOI: 10.3390/insects12040314 (date accessed: 27.05.2024).

23 Amendt J., Richards C. S., Campobasso C. P., Zehner R., Hall M. J. R. Op. cit. DOI: 10.1007/s12024-010-9209-2 (date accessed: 27.05.2024).

24 Owings Ch. G., Spiegelman C., Tarone A. M., Tomberlin J. K. Developmental variation among *Cochliomyia macellaria* Fabricius (Diptera: Calliphoridae) populations from three ecoregions of Texas, USA. *International Journal of Legal Medicine.* 2014. Vol. 128. Pp. 709—717. DOI:

Foreign entomologists emphasize the lack issue of standards and guidelines for research on the development of necrobionts [25].

Another important issue of forensic entomology is temperature regime. The succession and development of insects on corpses mostly depends on temperature. While assessing the postmortem period by succession or insect development, it is necessary to reconstruct the temperature conditions. Accuracy of postmortem estimation mainly depends on the accuracy of the reconstructed temperature conditions. Non-compliance with temperature regime is one of the causes of errors.

Forensic entomologists often use temperature data from local weather stations. According to *I. M. J. Hofer* (with co-authors) and *A. P. Johnson* (with co-authors), the temperature data of the weather station can be adjusted to adapt them to the peculiarities of the place of death [26]. Such errors are based on regression analysis of records made at the place of death and records from the station. In addition, some authors note that the correction protocol has uncertain advantages for the accuracy of postmortem evaluation [27].

The entomological factor, thermogenesis caused by insects is extremely important. It was discovered in clusters of fly larvae and has been actively studied ever since [28]. There is information about thermogenesis caused by *Necrodes Littoralis L. (Silphidae)* carrion beetles, in addition, researchers have proven that heat is produced in the nutrient matrix formed by adult beetles and their larvae by spreading their secretions over surface of the corpse [29]. Thermogenesis in larval assemblages is perhaps more common among

10.1007/s00414-014-1014-0 (date accessed: 27.05.2024) ; Richards C. S., Paterson I. D., Villet M. H. Op. cit. DOI: 10.1007/s00414-007-0201-7 (date accessed: 27.05.2024).

25 Frątczak-Łagiewska K., Matuszewski Sz. The quality of developmental reference data in forensic entomology: Detrimental effects of multiple, in vivo measurements in *Creophilus maxillosus L.* (*Coleoptera: Staphylinidae*). *Forensic Science International.* 2019. Vol. 298. Pp. 316—322. DOI: 10.1016/j.forsciint.2019.02.059 (date accessed: 27.05.2024) ; Midgley J. M., Villet M. H. Effect of the killing method on post-mortem change in length of larvae of *Thanatophilus micans* (Fabricius 1794) (Coleoptera: Silphidae) stored in 70 % ethanol. *International Journal of Legal Medicine*. 2009. Vol. 123. Pp. 103—108. DOI: 10.1007/s00414-008-0260-4 (date accessed: 27.05.2024).

26 Hofer I. M. J., Hart A. J., Martín-Vega D., Hall M. J. R. Op. cit. DOI: 10.1016/j.forsciint.2019.110028 (date accessed: 27.05.2024) ; Johnson A. P., Wallman J. F., Archer M. S. Experimental and Casework Validation of Ambient Temperature Corrections in Forensic Entomology. *Journal of Forensic Science.* 2012. Vol. 57. Is. 1. Pp. 215—221. DOI: 10.1111/j.1556-4029.2011.01900.x (date accessed: 27.05.2024).

27 Charabidze D., Hedouin V. Temperature: the weak point of forensic entomology. *International Journal of Legal Medicine.* 2019. Vol. 133. Is. 2. Pp. 633—639. DOI: 10.1007/s00414-018-1898-1 (date accessed: 27.05.2024) ; Dourel L., Pasquerault Th., Gaudry E., Benoît V. Using Estimated On-Site Ambient Temperature Has Uncertain Benefit When Estimating Postmortem Interval. *Psyche: A Journal of Entomology.* 2010. Vol. 6. 7 p. DOI: 10.1155/2010/610639 (date accessed: 27.05.2024).

28 Podhorna J., Aubernon C., Borkovcova M., Boulay J., Hedouin V., Charabidze D. To eat or get heat: Behavioral trade-offs between thermoregulation and feeding in gregarious necrophagous larvae. *Insect Science*. 2018. Vol. 25. Is. 5. Pp. 883—893. DOI: 10.1111/1744-7917.12465 (date accessed: 27.05.2024).

29 Matuszewski Sz., Mądra-Bielewicz A. Heat production in a feeding matrix formed on carrion by communally breeding beetles. *Frontiers in Zoology*. 2021. Vol. 18. Art. 5. DOI: 10.1186/s12983-020-00385-7 (date accessed: 27.05.2024) ; Matuszewski Sz. Op. cit. DOI: 10.3390/insects12040314 (date accessed: 27.05.2024).

carrion insects and, as it can significantly shorten the developmental interval, should be taken into account when reconstructing temperature conditions [30].

In some cases, conclusions of forensic medical examination do not coincide with the conclusions of entomological researches, so there is a need for a more detailed study of necrotic entomofauna.

## Conclusions

Necrobionts are an essential component of any biocenosis and are ubiquitous. In general, the vital activity of all types of necrotic insects is the mechanical grinding and decomposition of organic substances, mixing the latter with the soil, excretion of digestive enzymes into decomposing masses and vegetation under these masses, and (very importantly) a deterministic change in cycles and populations, which ensures self-regulation of decomposition process by arthropods.

Summing up, we should note that the use of entomology in forensic examinations is closely related to the development of forensic biology. As of today, even such issues as the composition of the fauna of non-microbionic insects, the biology and ecology of species associated with corpses in different regions of Ukraine under different climatic conditions remain insufficiently studied.

**Роль ентомологічних доказів у кримінальних розслідуваннях**

***Сергій Розумний, Дар'я Милостива, Світлана Полякова, Анна Бабченко***

*Проаналізовано вітчизняні й іноземні літературні джерела щодо використання некротичної фауни у криміналістиці. Мета статті — акцентувати увагу на важливості досліджень некротичної фауни для практичної криміналістики та висвітлити вплив некротичних ентомофілів на час настання смерті живого об'єкта (залежно від його виду й умов зовнішнього середовища), для чого застосовано біологічні й загальнонаукові методи. Наведено порівняльний аналіз активності представників некротичної фауни. Актуалізовано необхідність використовувати некрофауну в системній роботі судових експертів-біологів. Основне застосування судової ентомології як розділу прикладної ентомології — дослідження фауністичного комплексу некробіонтних членистоногих на виявленому трупі для забезпечення потреб слідства та суду. Ентомологічні знання дають змогу успішно виконувати класифікаційні, ідентифікаційні та діагностичні завдання, які постають у судово-експертній практиці. Оскільки процеси розпаду трупа й види некротичних комах на ньому різняться залежно від виду трупа та типу біогеоценозу, у якому цей труп перебував, то кожна із цих особливостей впливає на подальші криміналістичні дослідження. Здобуті ентомологічні дані є надійним джерелом інформації для з'ясування об'єктивної істини у процесах досудового слідства та подальшого судочинства. Водночас визначення часу смерті за трупною фауною може мати лише допоміжне значення, оскільки поява й розвиток комах дуже варіабельні. Сформульовано перспективи подальших досліджень, включно з удосконаленням методів ентомологічних досліджень (зокрема, у різних умовах середовища), доведено необхідність розвитку судової біології як невід'ємної складової криміналістичної науки.*

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***Ключові слова:*** *некрофауна; ентомологія; криміналістика; труп; живий об'єкт.*

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