REVIEW ON FORENSIC ENTOMOLOGY IN PANAMA

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ABSTRACT

Forensic Entomology is a scientific discipline that serves as support in the development of investigations in criminalistics and forensic sciences; to be able to estimate the possible time of death or if the body was moved to another place. This is possible by knowing the state of decomposition of the corpse, the identification of insect species and other arthropods, as well as determining their number and stages of development. Although in other latitudes the development of forensic sciences has made significant progress, there are still some limitations due to various factors, such as climate, whether the victim died from poisoning, among others. In Latin America, even with university degrees in Criminalistics and Forensic Sciences, more efforts are needed in research on the subject. The present work is a review of the research developed to date on Forensic Entomology in the Republic of Panama, which allows us to illustrate the most outstanding contributions in this area of knowledge. There are experiences with pig carcasses, pig viscera, rat carcasses and even human liver in different environments in Panama. These studies confirmed the importance of the order Diptera, especially the family Calliphoridae, followed by the orders Coleoptera and Hymenoptera.

Keywords: Arthropods, corpses, Forensic Entomology, Insects, Panama

INTRODUCTION

Forensic Entomology is a valuable tool that, since historical times, serves as a support to other forensic sciences in the possible resolution of criminal cases (Sardar et al., 2021). This is possible by recognizing the state of decomposition of a body, in which biotic and abiotic factors intervene; the identification of insect species, the quantity and stages of development found on the deceased can provide clues for the possible resolution of the case. Although several Latin American countries have made significant progress in this area, in other countries it is still incipient, relying in many cases on universities (Espinoza et al., 2020).

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Among the most important insects for forensic sciences in the world are the orders Diptera, Coleoptera and Hymenoptera. Of the first, the Calliphoridae family stands out; on which Šuláková and Barták (2013) conducted studies to establish collection standards for forensic entomological evidence, using domestic pigs (Sus scrofa) as a model. The authors collected 21 species of Calliphoridae, of which 10 are of forensic importance. They also determined that the use of pyramid traps together with pitfall traps and larval rearing in carcasses are useful for succession studies in invertebrates of forensic importance.

Regarding the order Coleoptera, De Almeida et al. (2015), updated the list of species of forensic importance in Brazil; finding in 16 states of that country, a total of 345 species, located in 16 families: Carabidae, Cleridae, Dermestidae, Geotrupidae, Histeridae, Hybosoridae, Hydrophilidae, Leiodidae (= Cholevidae), Nitidulidae, Ptiliidae, Monotomidae (= Rhizophagidae), Scarabaeidae, Silphidae, Staphylinidae, Tenebrionidae and Trogidae.

Regarding the order Hymenoptera, Ramón and Donoso (2015) highlighted the role of ants (Formicidae) as an important component of biodiversity and their study could help to solve criminal cases. Some ants are predators in leaf litter, so their activities can affect decomposition processes and influence the estimation of the post-mortem interval (PMI). They can also bite and sting bodies, as well as modify blood patterns.

In Panama, the Institute of Legal Medicine and Forensic Sciences has a Forensic Entomology Laboratory, where the probable time of death can be determined using the identification of cadaveric entomofauna larvae and the detection of human DNA in them (IMELCF, 2013). In 2007, the "1st International Workshop Seminar on Forensic Entomology", organized by the Gorgas Memorial Institute of Health Studies and sponsored by SENACYT, was held at the University of Panama (GORGAS, 2009). In addition, the University of Panama has developed training courses, such as the Seminar-Workshop "Evaluation of the Scene of Death through Forensic Entomology", aimed at professionals in forensic medicine, sociology and law, to broaden their knowledge of this branch of forensic science (Samaniego, 2006). Therefore, this work is a review of research on Forensic Entomology in Panama.

MATERIALS AND METHODS

For the present study, a review of specialized literature was carried out, both in English and Spanish, concerning research on forensic entomology, mainly those carried out in Panama.

Keywords such as forensic entomology, Calliphoridae, Sarcophagidae, insects in corpses, among other examples, were used. Databases such as Google Scholar, Scielo, Pub Med, Dialnet, among others, were consulted.

RESULTS

Studies with animal models developed in Panama

Among the animals frequently used as models are domestic pigs (Sus scrofa L.) and rats (Rattus norvegicus Berkenhout). Regarding the former, Bermúdez and Quintero (2002) studied the composition of arthropods associated with decomposing pigs and how clothing varied in the arriving species, as well as the time it took for Calliphoridae (Diptera) larvae to appear.

Garcés et al. (2013) studied Staphylinidae (Coleoptera) as forensic indicators in carcasses of domestic pigs, located in wooded areas of Fort Davis, Province of Colón. The collections were carried out by means of hand traps and entomological nets, being frequently observed in the swollen and putrefied stages. According to the authors, the species of Staphylinidae identified corresponded to Nordus fungicola Sharp (94 specimens) and Xenopygus analis Erichson (48 specimens); in addition to finding three morphospecies, Philothalpus sp. (375 specimens), Nordus sp. (53 specimens) and Xenopygus sp. (19 specimens). Additionally, the researchers indicated that the dominance of some species in space and time must be considered, in addition to their strong association with the stages of decomposition; with which it can be inferred that the Staphylnidae do not carry out activities on the corpses, if these are not colonized by larvae.

Corro-Chang (2013) developed a study of arthropod succession in rat carcasses (remains) using the modified Schoenly trap. According to the results, a total of 42 families of arthropods were collected during the 40 days of the field study. The most abundant insect orders were Diptera (54%), Hymenoptera (44%) and Coleoptera (1%); the species of forensic interest found were: Chrysomya megacephala (Fabricius, 1794), Ch. rufifacies (Macquart, 1843), Cochliomyia macelaria (Fabricius, 1775), Lucilia cuprina (Wiedemann, 1830), L. eximia (Wiedemann, 1819) and L. sericata (Meigen, 1826). The most colonizing species was Ch. megacephala, which was present in the study area from the beginning; followed in abundance throughout the decomposition process by the species Ch. rufifacies.

Studies conducted with tissue fragments (viscera) in Panama

Buitrago et al. (2011), studied the diversity of Calliphoridae species in Panama, in urban, rural

and wild environments; using fish viscera as attractants in McPhail traps for 24 hours. As a result, they collected 14,732 specimens of Calliphoridae, corresponding to subfamilies and 13 species. The authors found six asynanthropic species (Chloropococta idoidea, Hemilucilia semidiaphana, Huascaromusca sp., Mesembrinella bicolor, Mesembrinella umbrosa and Paralucilia fulvinota); one hemisynanthropic (Hemilucilia segmentaria) and six eusynanthropic (Chrysomya circa putoria, Chrysomya megacephala, Chrysomya rufifacies, Cochliomyia macellaria, Lucilia cuprina and Lucilia eximia).

González (2017) conducted a study on necrophagous flies of forensic interest in Panama, for which he used pig liver, which was under observation for 30 days, with temperatures ranging between 27 and 30°C. From this research, a total of 448 specimens of adult necrophagous flies were collected, corresponding to three families, four genera and five species. Cochliomyia macellaria was found to be the most abundant species (155 specimens), followed by the genera Chrysomya (129 specimens) and Sarcophaga (123 specimens); in addition, adults of Musca domestica (41 specimens) were obtained.

Garcés and Molinar (2020) investigated Calliphoridae of forensic interest in La Pintada, Coclé Province, using pig brain, liver and heart as bait. According to the results, the species Chrysomya megacephala and Cochliomyia macellaria were the most abundant; both are positively correlated, because their populations were the most captured, which reaffirms their importance as forensic indicators. However, the species Ch. rufifacies, Lucilia sericata and L. eximia, recorded low populations and were negatively correlated.

Garcés et al. (2020a) also investigated Sarcophagidae (Diptera), of forensic interest in forested and non-forested areas of Soberanía National Park, Panama. For this purpose, they used pork liver and heart as bait, making observations at 12, 24, 48, 72 and 96 hours. According to the results, 169 specimens were collected, corresponding to nine genera and 11 species; the most frequent being Pekia (= Pantonella) intermutans, Sarcodexia sp., Boettcheria sp., Pekia sp., Helicobia sp. and Sarcofahrtiopsis sp. Additionally, the flies showed a greater preference for the forested area and for pig heart.

Recently, Garcés et al. (2020b) studied necrophagous flies attracted to decomposing human livers at different time intervals in Panama City. For this purpose, they used four human liver samples provided by the Judicial Morgue of Panama. They implemented an observation methodology

similar to that of Garcés et al. (2020a); a total of 1003 specimens were collected, distributed among the families Calliphoridae, Sarcophagidae and Muscidae. The most abundant species in the study were Chrysomya megacephala (464 specimens) and Lucilia cuprina (117 specimens), followed by Lucilia sericata (55 specimens) and Lucilia eximia (47 specimens). Although these insects are excellent forensic indicators, the authors also pointed out that the greatest capture of C. megacephala occurred at 96 hours, suggesting that when they perceive a strong odor, they congregate to dominate the colonization, feed on exudates or oviposit.

Studies on human corpses in Panama

Bermúdez and Pachar (2010) investigated the arthropods associated with human corpses in Panama City, finding a total of 22 species (eight primary necrophages, three secondary necrophages, one dry-bodied necrophage, among other habits), during the removal of the bodies and autopsies. In this regard, the authors specified that the most common species were the flies Chrysomya rufifacies, Chrysomya megacephala and Cochliomyia macellaria (Diptera: Calliphoridae), both in immature and adult stages.

Aspects to consider in research on Forensic Entomology

Knowing both the species of insects and the stages of development allows estimating the post mortem interval (PMI), when locating a body; although the forensic methods used for its precise determination still need to be strengthened (Amendt et al., 2021). The results of the research carried out in Panama are similar to those reported by Mavárez-Cardozo et al. (2005), who stated that in the Neotropics, the genus Chrysomya (Diptera: Calliphoridae) is the most predominant and the main indicator of the MPI.

Another important aspect to consider is that, in tropical countries such as Panama, there are not so differentiated seasons, as is the case in the Iberian Peninsula. Begoña (2015), found that the duration of each stage in the decomposition process, varied in the different seasons, indicating that temperature and humidity are the most important variables that influence this process, lengthening it in the seasons with lower temperatures and shortening it in those with higher temperatures. This, in turn, may also influence the entomofauna associated with the bodies.

In addition, Begoña (2015), found in his study that the order Diptera, represented almost 60% of the entomofauna collected; which is similar to that reported by Corro-Chang in Panama (2013). While this reaffirms the importance of the order Diptera in forensic studies, followed by the orders

Coleoptera and Hymenoptera, mites (Acari) can also serve as substantial evidence in post mortem analysis of buried bodies, as suggested by the work of Rai et al. (2020).

For the appropriate use of animals in medical research, each country must legislate such practice; contemplating, in addition to bioethical reasons, legal aspects and animal welfare, from birth to use (Romero-Fernández et al., 2016). For its part, the University of Panama (2022), has a Bioethics Committee, which has among its functions:

- Evaluate research projects involving human beings, animal experimentation or the use of biological agents or genetically modified organisms.
- To develop training programs in research bioethics.
- Organize congresses and seminars on bioethical issues of general interest and disseminate public opinion on the ethical implications of scientific advances.
- To promote and participate in research on bioethical issues.
- To promote national and international relations in the field of Bioethics.

CONCLUSIONS

From the present study, it is concluded that Forensic Entomology in Panama needs to continue developing; a condition shared with some Latin American countries. It is worthy to highlight the effort made by Panamanian professionals, whose works have been consulted in this work. The importance for forensic science of the order Diptera was confirmed, especially the families Calliphoridae and Sarcophagidae, followed by beetles of the family Staphylinidae (Coleoptera) and the family Formicidae (Hymenoptera). However, other taxa such as mites (Acari) can also contribute to the solution of forensic cases. It is recommended that the institutions related to these sciences in Panama strengthen synergies with academia and other collaborators, so that this discipline continues to advance.

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