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Research

RESEARCH ON THE ECOLOGICAL SUCCESS ROLE OF THE MUSCIDAE (INSECTA: DIPTERA) SPECIES

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ABSTRACT

Since insects are the main dominant group of the Ecosphere, in terms of volume and number; there are many different scientific fields in which insects take place and study. "Forensic entomology" is the most current and interdisciplinary of these fields. Our study aimed to identify individuals belonging to the Muscidae (Insecta: Diptera) family, which has forensic importance within the scope of Nevşehir province. Muscidae species have forensic importance due to their wide distribution, presence in almost every environment and being close to humans. In the decay process, female individuals lay their eggs in natural cavities on the body, open wounds or on bloody clothes. Experiment and application part of the study was carried out in a period of approximately 6 months between April and October 2017. In this study, New Zealand rabbits which were inactive at Ankara University Faculty of Medicine Experimental Animals Laboratory were used. The carcasses are buried in a sheltered area surrounded by wire fences on the land of Nevşehir Hacı Bektaş Veli University. Burying to the soil at a depth of 30 cm was made, in pairs, with and without clothes. On the days determined as 10, 20, 30, 60, 90, 120 and 180, samples were collected from the body. As a result of evaluating the collected samples, 3 species from the Muscidae family, which are involved in the forensic entomological process, in the process of ecological succession, have been identified. These species are*; Musca domestica, Hydrotaea capensis, Stomoxys calcitrans.*

Keywords: Muscidae, Forensic entomology, Ecology, Fauna, Decay, Nevşehir

1. INTRODUCTION

In the case of a suspicious death, the location of the death and the correct determination of PMI (Post Mortem Interval) is very important for justice to be found. The determination of PMI for a body found in the first 24 hours after death can be said by measuring the body temperature precisely [1]. However, in cases where rot begins after the first 36 hours or even after the first 24 hours in hot weather, the sensitivity in determining PMI decreases. Even when the weather conditions are suitable, the margin of error increases in determining PMI. In this case, forensic science makes use of forensic entomology. Forensic entomology can be defined as its use in forensic events by examining insects in many ways, such as their biology, ecology and behavior in determining PMI and place of death in forensic research [2]. Forensic entomology can be defined as the evidence for the use of eggs and larvae of insects or arthropods coming from the corpse in the uncovering of some events from a legal point of view. Forensic entomology is a science that helps forensic medicine or, when it is insufficient, tries to estimate the death time of the victim directly or approximately by the adult and larvae of the insect and other arthropods on the body. Forensic entomology, whose main and most important purpose is to determine the time of death, is also used in uncovering events such as rape, child abuse, non-poisoning, drug and alcohol related deaths, unsolved deaths, smuggling incidents, traffic and aircraft accidents, insurance and inheritance problems. [3]. The most common use of forensic entomology is death. In the post-death period, the information about the death of the victim, the place of killing and whether it is transported can be obtained from the successions and activities of the arthropods [4]. In forensic entomology, insects must first reach the corpses in order to play a role in the decomposition process and to assist the forensic sciences. If a corpse is stored in a place that is completely isolated from its surroundings, or if the corpse is left in an area where the insects cannot survive, the insect may not be found on the body. In these cases, forensic science may not benefit from Forensic Entomology [5]. Insects, which are directly related to human life, also perform the most important step in the decay of their bodies. Insects coming to the bodies in the first step of decay are members of the Diptera ordo that come to the bodies in the first few minutes to start their decomposition period by leaving their eggs or larvae in suitable and sheltered areas of the bodies. The most common Diptera species in forensic entomology belong to the Calliphoridae, Sarcophagidae and Muscidae families. In their study in America, they prepared the morphological features and diagnostic key of the *Calliphora vicina* (Robineau-Desvoidy) and *Phaenicia sericata* (Meigen) species belonging to the periods of eggs, larvae and pupa [6]. Murray Galt Motter et al. systematically studied insects found in more than 150 bodies

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removed from the grave in Washington in the summer of 1896 and 1897. A similar study was carried out in Sweden by the researcher named Schöyen in 1895. The findings of Schöyen were feasible in grave fauna investigations [7]. Eduard Ritter von Niezabitowski, who worked as a medical researcher at the Medico-Legal Institute of Krakau University, used cat, rat, fox, blind rat and calf death in his experiments in May 1899 and September 1900. The priority of Niezabitowski's observations was flies. In his experiments he proved that the arthropods who came to the human body and animal body share the same fauna and made great contributions with the experiments he made in the field of forensic entomology [8]. Medical doctor Marcel Leclercq and Biology Professor Pekka Nuorteva are major researchers interested in forensic entomology from the 1960s to the mid-1980s. Leclercq and Nuorteva are among the first researchers to use forensic entomology in Europe to determine PMI [9]. In our country, the years when studies on the use of insects in forensic entomology came to the fore in the 2000s.These studies, which started primarily with review type researches, mostly continue in the form of graduate thesis studies in provinces such as Ankara, Eskişehir, Edirne, Samsun, etc. [10-22]: Among the researches within this scope, in his research which is an important and preliminary nature; Karapazarlıoğlu determined the insect species on the pig carcass and the succession they form on the carcass with his study in Samsun. Two white pigs were used in the study and it was observed that the pig carcass decomposed in five rotting stages: fresh, swelling, active rot, advanced rot and drying. Also in the decay process; It has been determined that Calliphoridae, Muscidae, Dermestidae, Formicidae, Cleridae, Staphilinidae, Vespidae Piophilidae, Forficulidae species play an active role. Of similar studies; Erzinçlioğlu, by describing the characteristics of the third stage larvae of 10 fly species coming to the meat; Phormia regina, *Phormia terranovae* and *Borellus atriceps* have been described. Current criminal entomology studies in our country are mainly; It is conducted by Sert, Açıkgöz et al., Karapazarlıoğlu, Özdemir, Şabanoğlu, Kökdener, Çoban [10, 12, 16, 18-22].

2. MATERIAL AND METHOD

2.1. Land work

The study was carried out on a land with steppe vegetation in Nevşehir Hacı Bektaş Veli University between April and October 2017. It was used by obtaining the necessary permissions for a land owned by the university. Attention has been paid to ensure that the land used is far from the faculties to the extent that it does not disturb the environment and people. The land is located at coordinates of 38 40 ', 45 "N 34 44', 20" E at an altitude of 1,500 meters from the sea. In our study, 14 New Zealand rabbits were used from the Laboratory of Experimental Animals in the Morphology building of Ankara University Medical Faculty. Necessary permits and documents were obtained for our land use and experiment work. The carcasses are buried in a sheltered area surrounded by wire fences, measuring (20x5) m = 100 m². The experimental area in the study was specially supplied for the study and required wire mesh etc. the hardware was created in accordance with the study. The embedding process with and without clothes was performed in a double group. The study was carried out in approximately 6 months between April and October 2017. The embedded carcasses were each measured in plain white and their weight was 5 kg.

2.2. Laboratory work

The forensic insect fauna, which came to them between April and October 2017, was investigated by embedding rabbits, rabbits with and without clothing at 5 m intervals. During the fieldwork process, ecological parameters affecting the study such as daily temperature, humidity, soil temperature of the area where carcasses are buried were recorded. Accordingly, the relationship between the temperature-humidity-soil temperature of the insects coming to the body was wanted to be revealed. Insect succession on carcasses was investigated on the days determined in the study procedure. In addition, how much the clothing factor affects the decay was examined. Physical changes in each decay phase of the bodies were photographed and recorded. Since the carcasses were buried starting in April, 10, 20, 30, 60, 90, 120, 180 day periods were collected and insect samples in the soil and corpses were collected.

3. RESULTS AND DISCUSSION

During 180 days, a total of 176 adults, about 60 larvae and 25 pupae samples were collected. Three species belonging to the Muscidae family of Diptera have been identified. These species are; *Musca domestica, Hydrotae capensis, Stomoxys calcitrans.* It was observed that these species came to the corpse from the 30th day of burial. It was observed that the months they arrived in the body were June, July and August. In Table 1, given together with the decay phases, removal / inspection times of superficial burials; In Figure 2; daily temperature-humidity-soil temperature graph values of August; has also given.

Figure 1. Decay stages

Table 1. Decay stages

Decay stage	Review Time
Fresh stage	1-30 day
Swelling stage	30-60 day
Active decay phase	60-120 day
Advanced decay stage	120-180 day
Drying phase	180-….day

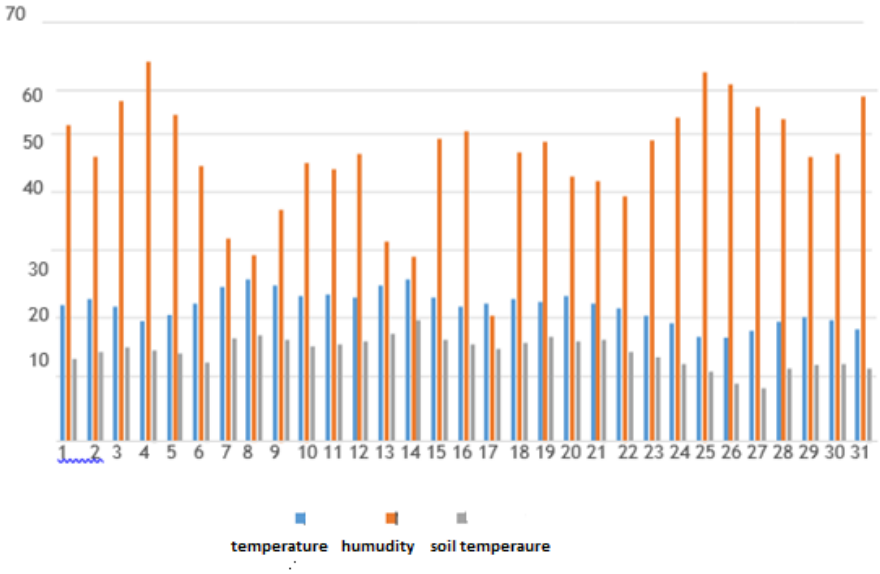

Figure 2. Graph of August temperature -humidity- soil temparature

3.1 *Muscıdae*

It is a family of 4,300 species that is common and known all over the world. Muscidae species have forensic importance due to their wide distribution, being in almost every environment and being close to humans [10].

3.1.1. *Musca domestica,* (Linnaeus, 1758)

Musca domestica Linnaeus 1758, (Housefly), is cosmopolitan, one of the closest living species of diptera. In general, they spread around 3 km of the areas where people are settled. It is not much away from this kind of person and therefore from the dwellings. After garbage, carrion and feces, they cause great trouble because they haunt human food. It is the vector of many pathogens. Adult and larvae prefer stools and spoiled herbal materials. Adults are also attracted by meat and sweet foods, and their larvae can develop sufficiently in these materials [11]. Depending on the temperature, the population reaches its maximum in late Spring and Summer. The rarity of this species on fresh corpse is due to the absence of excrement or intestinal contents [12]. Since they carry a wide variety of disease microbes in their bodies, they infect everything they travel. Because they leave feces to places they visit every 5 minutes. Cholera infects diseases such as diarrhea, dysentery, hepatitis, polio, food poisoning, salmonellosis, tuberculosis [13].

Figure 3. General view of *Musca domestica*

3.1.2. *Hydrotaea capensis* (Wiedemann, 1818)

Figure 4. General view of *Hydrotaea capensis*

It is a cosmopolitan species with a dark metallic gloss and greenish blue color, about 4 - 5.5 mm in length. The palp and antenna are black, calyptras are white or yellowish, the frontal triangle extends to the middle of the forehead and the posterior tibia is slightly curved [14].

3.1.3. *Stomoxys calcitrans,* (Linnaeus, 1758)

Stomoxys flies are blood-sucking obligates, and some species cause significant economic losses in livestock and other warm-blooded animals in many parts of the world. There are 18 species identified so far in the Stomoxys lineage (Diptera: Muscidae). Along with *Stomoxys calcitrans*, which is a cosmopolitan species, other Stomoxys species easily attack pets. Both females and males of Stomoxys flies, which generally show an aggressive and persistent diet, suck blood. Although these flies, which are

also called barn flies, have a wide host variety, rats, guinea pigs, rabbits, monkeys, horses, camels, goats, pelicans and cattle make up their original mansions. Although these flies lead a very active life, they are especially problematic in farms. In addition, they are very important due to their potential to be seen in the settlement areas and beaches close to agricultural production. Severe insertion activities of Stomoxys flies can cause serious problems resulting in milk production and live weight loss. It has been reported to cause losses of 19% in live weight and 40-60% in milk yield [15].

Figure 5. General view of *Stomoxys calcitrans*

3.2. Ecological succession of *muscidae* by dressing factor

Our determinations and evaluations here are given in Table 3.

Table 3. Decay process: In terms of the dressing factor

	DRESSED	**UNDRESSED**
10 th DAY	Eggs were observed in the ear and anus.	Eggs were observed in the ear.
20 th D AY	……..	……
30 th DAY	*Musca domestica*	*Musca domestica*
60 th DAY	*Musca domestica, Hydrotea capensis*	*Musca domestica*
90 th DAY	*Musca domestica, Stomoxys calcitrans*	*Musca domestica, Stomoxys calcitrans*
120 th DAY	*Musca domestica*	*Musca domestica*
180 th DAY	**……**	**……**

4. CONCLUSION

Table 4. Classification table

PHYLUM	**CLASSIS**	**ORDO**	**FAMILY**	**SPECIES**
ARTHROPODA	INSECTA	DIPTERA	MUSCIDAE	*M. domestica, H. capensis, S. calcitrans*

Forensic entomolog, tries to estimate the time of death of the victim ("corpse") near or approximately, from adult and larvae of insects and other arthropods on the corpse, in cases where it is or is inadequate. is a science. In cases where the moment of death is not known precisely, it is legally important to estimate the time elapsed after death. The most common use of forensic entomology is death. In the post-death period, the information about the death of the victim, the place of killing and whether it is transported can be obtained from the successions and activities of the arthropods [4]. For this purpose, in this study we carried out in Nevşehir, fauna with forensic importance affecting the decay process of the corpse was identified. Since our bodies were buried in the ground and the air temperature was low, the decay process was slow compared to the exposed bodies compared to other studies [16]. The burial of the corpse in the ground will affect the speed of zthe flies reaching the corpse as well as the decay speed. The decay rate of an exposed body can be 4 times higher than the buried corpse. If the soil where the corpse is buried is not very moist and buried deep, the decay rate slows down and the time to stay in the soil increases without degradation.

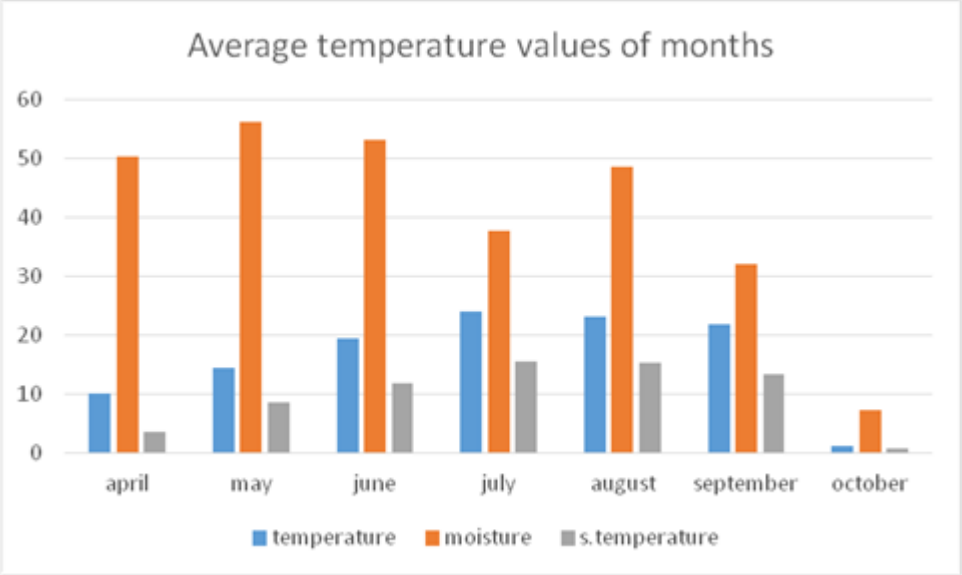

Figure 6. Average temperature values of months

Being buried in the ground negatively affects fly circulation. Buried insects affect the time spent by insects to reach the corpse, the insect sequence, species, and decay stages [17]. No rot or adult insect was found in the bodies during the investigation in the initial phase. The reason for this is that since the beginning of April, the weather is not hot enough, the precipitation is high and the carcasses are buried as frost. During the experiment period, temperature, humidity and soil temperature data covering April 2017-October 2017 were determined. It has been determined that the determined temperature, humidity and soil temperature data and their interactions are the most effective factors in both insect development and rotting. As a result; scope of work; As a result of the burial in the soil at a depth of 30 cm, in pairs and without clothes. On the days determined as 10, 20, 30, 60, 90, 120 and 180, samples were collected from the body. As a result of evaluating the collected samples, 3 species from the Muscidae family, which are involved in the forensic entomological process, in the process of ecological succession, have been identified. These species are; *Musca domestica*, *Hydrotaea capensis*, *Stomoxys calcitrans.* Data obtained from superficial burials with and without clothing were not significantly different in terms of Muscidae faunistic data. However, the outfit; it affects the decay of the corpses, as it provides moisture retention; It has been determined that it accelerates the decay process and stages in balancing conditions parallel to the temperature and soil temperature increase. The rotting process is much more active in the summer months.

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