



## Technical note

# Preliminary data on carrion insects in urban (indoor and outdoor) and periurban environments in central Spain



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## ABSTRACT

Although most cases involving entomological evidence occur in urban environments and under indoor conditions, there is a lack of studies determining the insect fauna of forensic importance in those environments. In the current paper we provide the first data on the composition of the forensically important insect species occurring in periurban and both indoor and outdoor urban environments in central Spain. Insects were collected fortnightly by means of carrion-baited traps, uninterruptedly during one year. Most species and individuals were collected in the periurban site, whereas the indoor urban site showed the lowest number of species and captures. Moreover, the composition of species differed among environments and seasons. A few species occurred under both indoor and outdoor conditions, including the blowfly *Calliphora vicina* and some Sarcophagidae species. These preliminary results suggest interesting differences in the insect composition between environments and conditions which may be of forensic importance, and represent a first step to further research into the application of insects to forensic investigations in urban environments of central Spain.

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## 1. Introduction

Determining the insect fauna associated with carrion in a given area and under certain conditions is an essential first step to the application of entomology in forensic medicine. Indeed, despite forensic entomology having become one of the most reliable and promising tools in legal and forensic investigations [1,2], there is still the need for more basic research in order to strengthen those entomological methods for forensic application. For instance, some studies have shown differences in the composition of the carrion fly fauna among urban and rural areas [3–7], but there is a lack of studies on this issue taking into account the necessity for baseline data for specific regions and seasons [8]. This is of pivotal importance as determining the insects' preference for specific habitats may reveal the postmortem relocation of a cadaver [7,9] and, moreover, it has been noted that most of the cases involving entomological evidence occurs indoors [10,11]. Considering that

the access for insects to a corpse has been described as one of the most important variables affecting decomposition [12,13], several authors have highlighted not only the importance of knowing the insect fauna at indoor scenarios, but also that most of the studies on carrion insect fauna and its successional patterns take place outside [2,10]. Accordingly, whereas several studies on forensically important insects have been made on carcasses throughout Europe [e.g. 6,14–18], only few of them were placed within urban areas, but usually under outdoor conditions [e.g. 17,18].

In the specific case of the Iberian Peninsula, several studies have provided successional data from outdoor periurban environments throughout this region [19–21], and the carrion insect fauna has been defined in the natural environments of central Spain [22,23]. However, there are virtually no studies determining the forensically important fauna in urban environments, under either indoor or outdoor conditions, with the exception of those data from case reports [24,25]. It must also be noted that, because of the highly variable temperature and climate throughout the year in the Iberian Peninsula [26], the composition of the carrion insect fauna changes significantly among seasons within this region [22,23].

The aim of the current study is to provide the first data on the composition of the insect fauna of potential forensic interest

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among urban (under both indoor and outdoor conditions) and periurban environments of central Spain, as well as on the changes in the species composition throughout one year.

## 2. Material and methods

The study was carried out in the city of Alcalá de Henares (central Spain) and surroundings. This is a medium sized town of more than 200,000 inhabitants (data from the National Institute for Statistics), located about 30 km from the capital of Spain. The city area is located in the mesomediterranean bioclimatic level [26], characterized by hot and dry summers and humid and cold winters.

Three different sites were selected to obtain samples of insects. First, an outdoor periurban environment (UTM 30T 469337, 4481415; 596 m a.s.l.): a plot belonging to the University of Alcalá, located on the outskirts of the city; it is an open, non-urbanized area covered by herbaceous vegetation with some scattered shrubs. Second, an outdoor urban environment (UTM 30T 472091, 4484682; 595 m a.s.l.): a cobbled courtyard with some weeds inside a large (approximately 3.12 ha), abandoned military building located in the center of Alcalá de Henares. Third, an indoor urban environment (UTM 30T 472091, 4484682; 595 m a.s.l.): a closed room with a closed window oriented toward the North, getting sunlight during half of the day, inside the same military building. Despite both the door and the window being closed, there was a space between the door and the floor of approximately 2–3 cm, thus allowing the access of the insects into the room. A weather station was placed in the University of Alcalá, located at approximately 1 km from the periurban site and at approximately 3 km from the urban site, recording an average annual temperature of 14.8 °C (average minimum temperature: 8.6 °C; average maximum temperature: 21.5 °C) and an annual rainfall of 426.4 mm during the period of study.

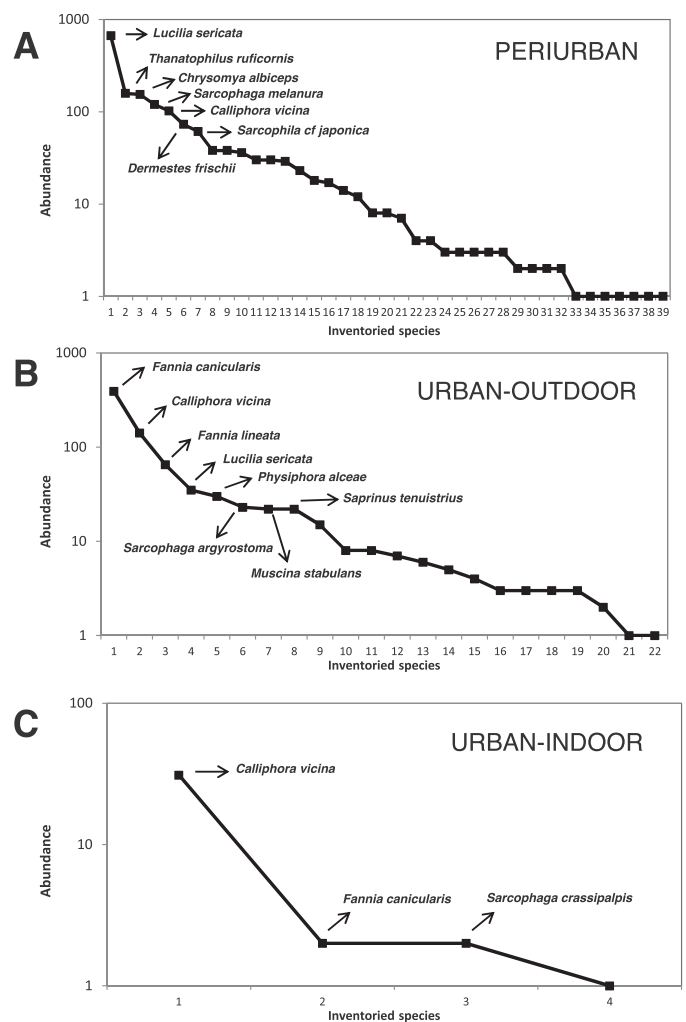
To collect necrophagous insects we used carrion-baited traps. Although there is a wide variety of trapping methods for sampling necrophagous flies [e.g. 3,4,27], we used a trapping method which has shown to be very effective in collecting both forensically important Diptera [23,28] and Coleoptera [22]. Carrion-baited traps were made by modifying an earlier design [29] and baited with squid. The traps consisted basically of a plastic recipient containing a plastic funnel and a collecting jar with an ethylene glycol solution for both killing and preservation; the plastic recipient was covered with a plastic plate with a jar attached containing the bait. Both detailed description and schematic illustration of the trap can be found in Baz et al. [28]. Each trap was protected with a wire mesh cage of 10 mm to avoid the action of scavenger vertebrates. One trap was installed at each site and maintained from October 2005 to September 2006. Traps were visited every 15 days; on each visit, the sample was removed and the bait replaced; hence, the traps were operating uninterruptedly during one complete year. At the end, 72 samples had been obtained (3 traps × 24 times). For the comparison between habitats, data were pooled into the four seasons for simplicity: winter (samples from December, January and February), spring (samples from March, April and May), summer (samples from June, July and August) and autumn (samples from September, October and November). The collected specimens were either preserved in 80% ethanol or oven-dried and pinned, and deposited in the collection of the Department of Life Sciences of the University of Alcalá.

## 3. Results

A total of 18,668 individuals belonging to 54 necrophilous and necrophagous insect species were collected in carrion-baited traps

in the sampled sites during one year. A complete inventory of these species, including their taxonomic authorities and numbers collected in each sampled site and within each season, is provided as supplementary data. Most species and individuals were collected in the periurban site (50 species, 16,864 individuals). In the urban site, the outdoor trap collected 1696 individuals belonging to 33 species, whereas the numbers of species and individuals collected in the indoor trap were the lowest by far (9 species, 106 individuals). In the overall captures, the most abundant species were *Musca domestica*, *Chrysomya albiceps*, *Physiphora alceae*, *Lucilia sericata* and *Sarcophila cf. japonica* (see supplementary material). Among the Fanniidae flies, the occurrence of the species *Fannia lineata* and *Fannia conspecta* is remarkable, as the current captures represent, to the best of our knowledge, the first record of these species from Spain, thus confirming their wide distribution in the Iberian Peninsula after having been recorded from Portugal [30].

The number and composition of collections differed among environments and seasons. During winter months, the traps collected virtually no insects (see supplementary data). During spring months (Fig. 1A), the blowfly *L. sericata* was clearly the dominant species in the periurban site, together with the necrophagous beetle *Thanatophilus ruficornis* and the flies *Ch. albiceps*, *Sarcophaga melanura* and *Calliphora vicina*. However, in



**Fig. 1.** Distribution of the abundances of the inventoried species at the three sampling sites, during spring season. Points make reference to the species collected at each sampling site. For clarity, only the most abundant species at each site are labeled. A – periurban site, B – outdoor urban site, C – indoor urban site.

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