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ORIGINAL ARTICLE

# Carrion beetles succession in three different habitats in Riyadh, Saudi Arabia



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**Abstract** A main objective of the study is the establishment of a forensic entomological database for Riyadh, Saudi Arabia. Decomposition processes and beetle succession were analysed on rabbit carcasses in three different habitats (agricultural, desert and urban) in the period from May to July 2014. Due to the effects of the high temperature at the study sites, carrion reached the dry stage within 12 days in the agricultural habitat, and 6 days in the desert and urban habitats. A total of 125 beetles belonging to eight species and five families were collected during the decaying process, with their abundances increasing from the fresh to decay stages. The prevailing species belonged to the families of Dermestidae and Histeridae. It was not possible to confirm any definitive relationship between the occurrence of a single species and a particular stage of decomposition. The beetle communities were also not distinctively different between desert and urban habitats, but a distinct community was evident in the agriculture habitat. In addition, there were distinct beetle communities between the decay stage and the other stages. The dry stage recorded the lowest number of beetles. This study indicated that, the habitat type had an effect on the decay process and the abundance rate of the beetles.

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## 1. Introduction

Insects occurring on corpses can be analysed to help determine the post-mortem interval (PMI) specific to a defined biogeographical region (Watson and Carlton, 2003; Grassberger and Frank, 2004; Matuszewski et al., 2010b). The rate of decomposition, insect succession, seasonal availability and composition of carrion communities are influenced not only by the biogeoclimatic zone, but also by temperature and humidity (Mann et al., 1990), by the type and the physical state of the carcass remains (Anderson, 2010), as well as by habitat loss and fragmentation (Anderson, 2010; Caballero et al., 2012).

Coleoptera is the largest order, containing about a third of all known insects (Byrd and Castner, 2010). Beetles occupy an ecologically assorted piece of the carrion community, thus providing a wide range of sources of potential evidence in

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medico-legal investigations (Schoenly et al., 2007). Necrophilous beetles, which cannot be replaced by flies, play a pivotal role not only in estimating minimum postmortem interval time (m-PMI) of dry skeletal remains in the later stages of decomposition, but also to determine the destruction and posture changes of carcasses (Kulshrestha and Satpathy, 2001). Beetle communities with criminological significance differ according to the region, but the most common beetle species, included in the following families were; Cleridae, Dermestidae, Histeridae, Scarabaeidae, Silphidae and Staphylinidae (Hart and Whitaker, 2005). Guo et al. (2012) reported that, most of the developmental studies of carrion related insects have been focused on flies, but beetle development have been largely neglected.

The work reported here sought to test (i) whether different habitats (agriculture, desert and urban) have an effect on beetle diversity, community structure and succession patterns and (ii) whether each habitat and each stage of decaying shows a degree of taxonomic differences. Ultimately, we provide detailed information on carrion beetle communities and succession patterns that can be used as an entomological reference in Riyadh, Saudi Arabia.

## 2. Material and methods

The study was conducted in three different ecological habitats. The first site was an agricultural area (24°44'36.54" N, 46°33'45.12" E), where the nearest human dwelling was approximate 1 km from the study site, and which contained many palm trees and grasses. The second site was a desert area (24°47'41.61" N, 46°32'38.47" E), where the nearest human dwelling was approximate 4.5 km from the study site. At this site, the soil, which was composed mostly of rocks, was extremely hard-packed and dry. The third site was an urban area (24°43'16.51" N, 46°37'2.45" E), beside the building of the College of Science at King Saud University. Human dwellings were located close to this site. The study was repeated three times, where it was conducted from 9 to 21 May, 15 to 28 June and 11 to 23 July 2014.

Nine live mature rabbits (*Oryctolagus cuniculus* Linnaeus) were used because, it is not allowed to use pigs in experiments in Saudi Arabia. AbouZied (2014) has shown that rabbits can

be used successfully to study decomposition succession in KSA. Rabbits were procured at the sites, euthanized with chloroform, weighed (mean = 1.57 ± 0.44 kg) and divided into groups of three. Three rabbits were located in each of the agriculture, urban and desert habitats. Sampling occurred daily after the carcasses were set down. This pattern was decided upon so as to include decomposition stages up until the dry stage had nearly been reached. In order to exclude scavengers, the rabbits were placed in steel cages (55 cm × 40 cm × 24 cm), which were designed specifically to allow insect access, but prevent them escaping, instead trapping them in a chamber at the top of each cage. For these purposes, each cage was made of a frame composed of a layer of wire screening from a rigid steel 2 cm mesh to keep out scavengers but allow insect access.

For each carcass, four pitfall traps (10 cm in diameter) were used. The four traps were placed around each rabbit carcass. On each sampling day, each trap was filled up with a solution of water, soap and salts. Only adults were included in the counting of collected insects during this field study. Collections were made daily during the sampling period. By using specialized taxonomic keys, the collected beetles were classified into family and species levels (Borror et al., 1989; Catts and Haskell, 1990; Arnett et al., 2002; Navarrete-Heredia et al., 2002) and confirmed by Prof. Ali Maghrabi, King Saud University (see Acknowledgments). Daily temperatures for each habitat were recorded using a Lascar EL-USB-2 data logger (Fig. 1).

In order to compare the mean durations of the decomposition stages between the three different habitats, ANOVA was applied followed by Bonferroni correction. SPSS software (Version 15, SPSS, Chicago, IL) was used for the statistical analyses. A significance level at  $P \leq 0.05$  was used in all tests.

## 3. Results

The rate of decomposition was 12 days in the agricultural habitat and six days in the desert and urban habitats. The fresh stage lasted two days in the agriculture habitat but only one day in desert and urban habitats. The bloat stage was completed by day 3 in the agricultural habitat and by the early hours of day 2 in the desert and urban habitats. The duration of the decay stage also varied between habitats. This stage

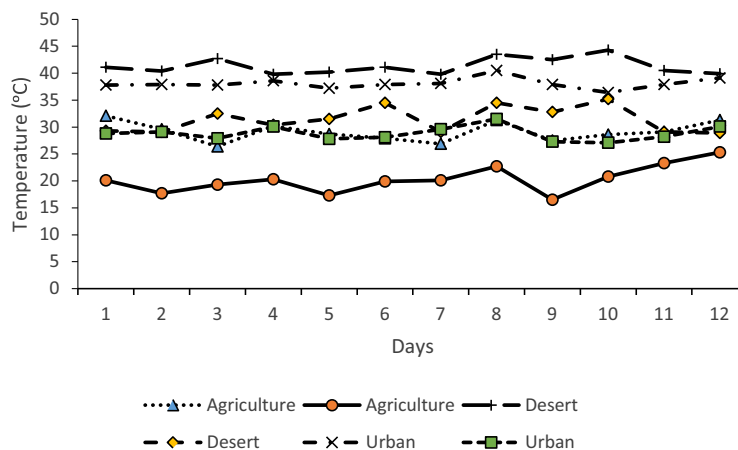


Figure 1 Temperature data for the study period in different habitats.

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