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Decomposition and arthropod Succession on two monkeys (*cercopithecus aethiopicus)*

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Abstract
This study was carried out at the Faculty of Science, Department of Zoology. Monkeys were used as a model to mimic decomposition of a human cadaver. For this study two monkeys (freshly dead) were exposed to insects in two different sites, one site was in the sun and located on the roof of the Zoology Department, and the other was in the shade and located under a tree near the animal house of the Zoology Department. The Calliphoridae, Sarcophagidae and Muscidae (Diptera) are the primary insects associated with carrion followed by Histeridae, Cleridae and Dermestidae (Coleoptera).
There was no difference in the arthropod community collected from sun and shade sites of the two animals; but the decomposition was faster in the sunny area than in shaded one.

Keywords: Decomposition, succession, forensic entomology.

Introduction

Forensic entomology refers to insects and related arthropods and their association with any legal matter. Forensic entomology is divided into three categories: urban, stored product and medicolegal (Catts and Goff 1992; Hall 1990). Urban forensic entomology includes civil law actions and litigations involving arthropods in houses. Stored product forensic entomology includes arthropod infestation of edible commodities. Medicolegal forensic entomology includes arthropod association with felonies such as murder, suicide and rape. In its most practical form, information dealing with carrion insect ecology has been used to estimate the minimum elapsed time since death in homicide cases.
Insects are the primary fauna associated with carrion (Goff and Odom 1987; Payne 1965; Tantawi *et al*.1996). It is known that there is an assemblage of insect species that are attracted to decomposing animal remains and play an active role in the decay process (Anderson and Cervenka 2001; Lord 1990). Certain species in the orders Diptera and Coleoptera represent the majority of the total necrophagous fauna found on carrion (Greenberg 1991; Payne 1965).
Many of these insects have been classified according to their ecological role in carcass decomposition. Typically, carrion is rapidly invaded first by necrophagous flies in the following families: Calliphoridae, Sarcophagidae and Muscidae. This results in the presence of huge numbers of fly eggs and larvae, thereby providing an abundant food supply for predacious beetles such as silphids, staphylinids and histerids. As the carcass decomposes and food resources become depleted, it becomes attractive to about 15 different insect species for feeding and reproduction. Species in the families Piophilidae, Cleridae and Nitidulidae are typically associated with the carcass during the later stages of decay and the Dermestidae are attracted to the dry remains (Payne and King 1970; Smith 1986; Tantawi *et al*. 1996). Since many of these carrion insects are attracted during these different stages of decomposition, it has been shown that carrion is invaded by certain insect species in a typical sequence or succession (Anderson and VanLaerhoven 1996; Bourel *et al*. 1999; De Souza and Linhares 1997; Early and Goff 1986; Goff and Flynn 1991; Haskell *et al*. 1989; Lord and Burger 1984; Louw and van der Linde 1993; Payne 1965; Tantawi *et al*. 1996; Tullis and Goff 1987).
Many factors can affect insect succession and the decomposition of carrion. Factors such as temperature, season, time of day, accessibility and physical position of a carcass, size and type of carcass, vertebrate scavengers, insect abundance and the biology and geographical distribution of the necrophagous insects can influence the time of arrival and the duration of stay of insects on the carrion (Anderson 2000b; Dillon 1997; Hall and Doisy 1993; Payne 1965; Tessmer and Meek 1996; Tullis and Goff 1987). These many factors make it necessary to study insect succession on carrion in different regions and under different conditions.
Generalizations can be made regarding these factors in estimating time of death; however, it leaves open to the possibility of erroneous conclusions that are detrimental to legal cases involving murder and other serious crimes.

Materials and methods

This study was carried out at the Faculty of Science, Department of Zoology. Monkeys were used as a model to mimic decomposition of a human cadaver. For this study two monkeys were killed by injection with chloroform and exposed to insects in two different sites, one site was in the sun and located on the roof of the

Zoology Department, and the other was in the shade and located under a tree near the animal house of the Zoology Department.

Daily observations were made and recorded, ambient air temperature was taken twice a day, weekly photos were taken.Larval sample of flies were collected by forceps and put in container to preserve some and rear the rest to complete the life cycle. Maggots were killed by dropping them in hot water (about 70-80°C), then preserved in 70% alcohol and stored for identification by dissecting the spiracles later.

Results

(1) The day of death, was the start of the fresh stage of decomposition and ends with the first evidence of bloat, (Plate 1 a, b), ambient air temperature in the shade ranged between (27— 31ºC) in the shade and (31— 35ºC) in sun during the study period.

(2) The arrival of adult insects *Musca domestica* (Muscidae) occurred on second day. The arrival of adult insects (Calliphorids and Sarcophagids) *Chrysomya putoria* and *Sarcophaga tibialis* respectively and oviposition occurred after 3days (Plate 2 a, b).

(3) Clown Beetles (Histeridae) were observed under carcass only in sunny site

(4) On day 4 slight bloating occurred accompanied by odour, Bloat, or putrefaction, is the most distinctive part of carrion decomposition. Gas production, caused by metabolism of anaerobic bacteria, causes the abdomen to expand.

(5) At this stage more adults of (Calliphorids and Sarcophagids) were present in great numbers and continued to lay eggs and larvae, also more clown beetles especially in the sunny site (Plate 3 a, b).

(6) Active decay Stage started on day 6, the decay stage begins when the carcass deflates from perforations in the abdominal wall, eggs and first and second instar larvae were observed in the mouths and between hind limbs (Plate 4 a, b). Adult beetles Necrobia rufipes (Cleridae) were observed only under carcass in shaded area.

(7) *Dermestes maculatus* (Dermestidae) were observed on day 7, on which the advanced decay stage started. It begins when most of the fly larvae have left the carcass. All of the internal organs are reduced to a paste-like or cheesy material (Plates 5a, b). Adult dermestid beetles increased gradually especially in sunny carcass. Four days later eggs of Dermestidae were observed on dry carcasses and after 10 days larvae were observed on remains (Plate 6 a, b).

(8) After all this matter is consumed and desiccated, the dry remains stage begins.

All of these stages vary in length of time and are dependent on factors such as insect abundance and activity, geographic location, temperature, Humidity, rainfall, habitat, season and carcass size and type.

Discussion

This study was carried out at the Faculty of Science, Department of Zoology, the sunny site was an open site on the roof of Zoology Department (approximately 10 meters high) and the shaded site was on the ground near the animal house.

Bloat stage of decomposition is inflation of the abdomen due to releasing of gases such as hydrogen sulphide, sulphur dioxide, carbon dioxide, methane, ammonia and hydrogen as a result of breakdown of tissue by bacteria.

Insects associated with carrion may be classified according to their ecological

role. Necrophagous insects feed and breed on the carrion itself. These species typically occur in succession and respond to decompositional changes of the carcass. These species are often the most important in providing useful forensic information. The Calliphoridae are the most prominent necrophages. Sarcophagids, Muscids and Piophilids may also be necrophagous. Silphids, Clerids and Dermestids also feed and breed within the carrion (Catts and Goff 1992; Keh 1985; Payne 1965; Smith 1986).Staphylinids and Histerids are important predators of carrion fly larvae and are therefore important in terms of the ecological dynamics of carrion (Tantawi *et al*.1996). Gill (2005) found that there was no difference in the arthropod community collected from sun- and shade- exposed pig's carrion. This is consistent with our findings. Generally the decomposition was faster in the sunny area than in shaded site. Again Gill (2005) reported that all stages of decomposition took longer time in the shaded area.

a) b)

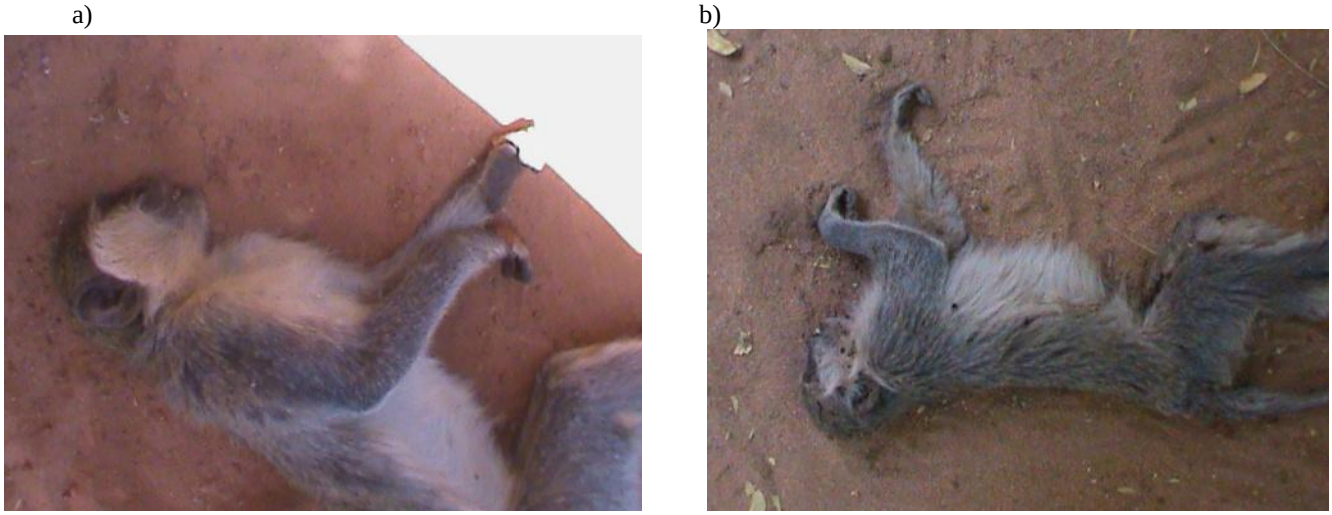

Plate 1 a) fresh stage of carcasses decomposition in the sunny site, b) fresh stage of carcasses decomposition in the shaded site

Plate 2 adult insects: calliphorids and Sarcophagids)

a)

a)

Plate 3 a) and b) slight bloating

a) b)

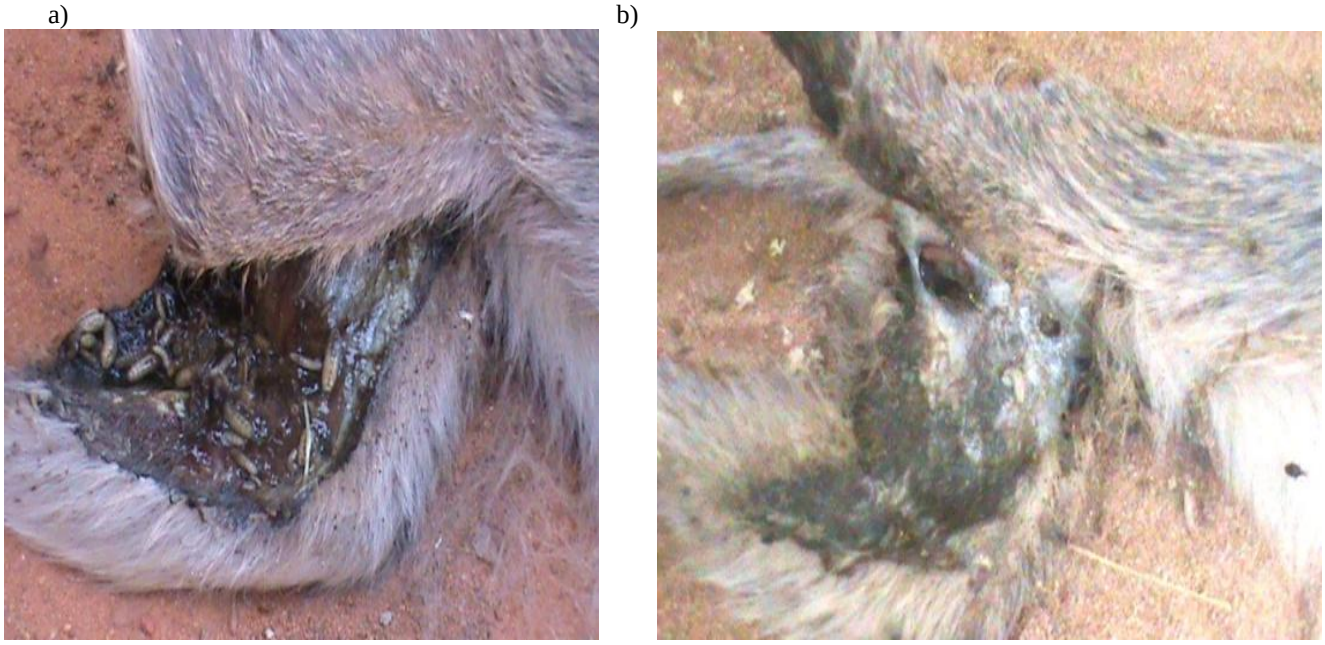

Plate 4 a) and b) Active decay Stage (Larvae between hind limbs)

a) b)

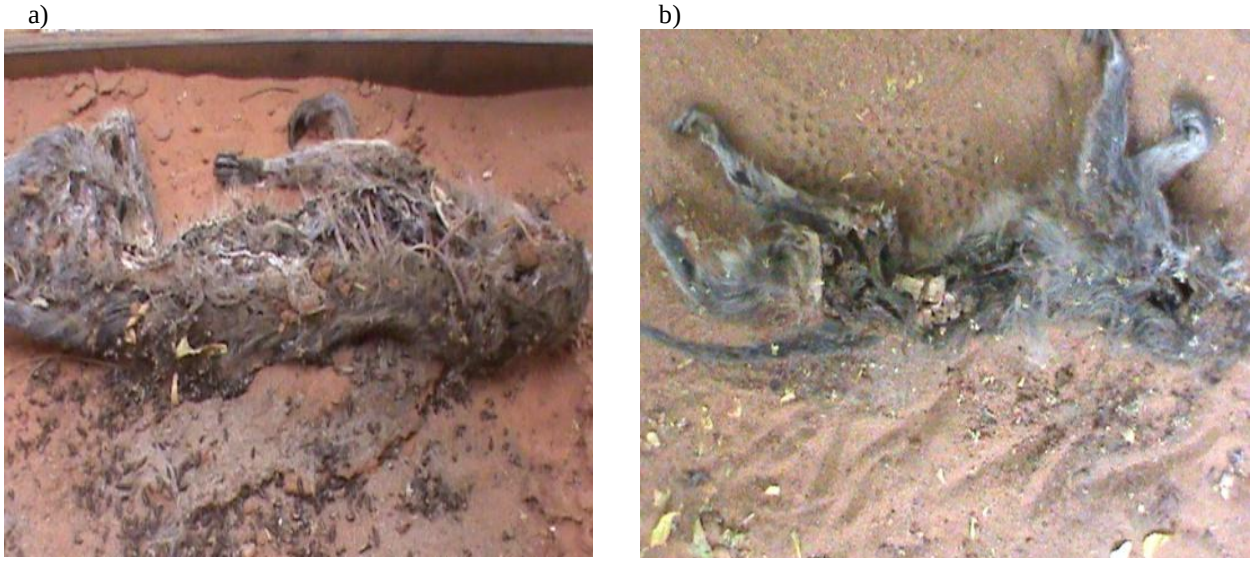

Plate 5 a) and b) advanced decay stage

a) b)

Plate 6 a) and b) Dermestid larvae

Five weeks later

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