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Insect succession on Rabbit (*Oryctolagus cuniculus* L.) carrion in District Peshawar

Fazli Amin*, Syed Fahad Shah

Department of Entomology, The University of Agriculture, Peshawar, Pakistan

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Abstract

The present research work was carried out to study insect succession on rabbit carrion in District Peshawar at Agronomy Research Farm (ARF), The University of Agriculture Peshawar, during the year 2015. Five decomposition stages recorded were fresh, bloating, decay, post decay and dry stages. A total 16 species of insects from 11 families in 3 orders i.e. Diptera, Coleoptera and Hymenoptera were collected and identified from rabbit carrion. Collected insects species from order Diptera during fresh, bloating and decay stages were *Chrysomya megacephala* (Fabricius), *Chrysomya rufifacies* (Maquart), *Lucilia illustris* (Meigen), *Lucilia ampullacea* (Villeneuve), *Phormia regina* (Meigen), *Sarcophaga* sp., *Musca domestica* (Muscidae) while from order Coleoptera the species such as *Gnathoncus* sp., *Saprinus* sp. and *Scarabaeid* sp. were observed in the late bloating and decay stages, *Necrobia rufipes, Necrophila rufithorax* and *Staphylinid* sp. were recorded in decay and post decay stages while *Dermestes maculates* was noticed in post decay and dry stages. Ants were recorded throughout the decomposition period and red wasps were observed in bloating and decay stages in particular.

* **Corresponding Author:** Fazli Amin ✉ fazliamin395@gmail.com

Introduction

Forensic entomology is a tool that is commonly used to evaluate the time interval between death and finding of the dead body called the postmortem interval (Anderson and Vanlaerhoven, 1996). It is based on the ecology of the specific insects that feed on the carrion and rate of their development on the dead body (Hall 1990).

Insects and other arthropods that feed on carrion make a discrete faunal succession which is associated with several stages of decomposition (Smith, 1986). The knowledge of the different immature stages of associated species and their developmental rates may provide a signal of the Post Mortem Interval (Smith, 1986). Insect specimen can be used as reliable indicators in medico legal death investigations for estimating the postmortem interval of the carrions (Byrd, 1998).

Insect are the first visitors on the carrion immediately after the death (Anderson and Vanlaerhoven, 1996; Dillon, 1997). It is evident that various insect species are attracted by animals carrion and play important contribution in the decomposition process (Anderson and Cervenka, 2001). Majority of macrophages insect species belong to orders Coleopteran and Diptera (Greenberg, 1991). Among the insects visiting carrion, larvae of flesh flies (Sarcophagidae) and blowflies (Calliphoridae) consume the maximum carrion (Early and Goff, 1986). The decomposition of carrion may be divided into 5 main stages: Fresh, bloating or putrefaction, decay, post decay and dry stage (Tullis and Goff, 1987). Every stage of decay is attractive to different species and offers an ideal habitat for some species so that they could lay eggs and feed. This results in a series of insect species occupying the carrion in early stages (Keh, 1985; Turner, 1991). These stages can be illustrated as follows:

Fresh stage

A body is considered in the stage fresh from the time of death until the first signs of swelling. This is the stage in which the blow flies (Calliphoridae) and flesh flies (Sarcophagidae) reach the body and begin to lay eggs or larvae (Anderson and Van Laerhoven, 1996).

Bloating stage

This stage began with slight swelling of the abdomen and discharge of blood from the nose. Anaerobic bacteria in intestine of the carrion produce gases as a result of metabolic processes that cause swelling in the abdomen. The body may later assume the balloon shape. Smell also started in this stage. The number of Sarcophagidae and Calliphoridae are usually at peak during this stage (Tullis and Goff, 1987).

Decay stage

This stage initiate when the gases are released and the body of the carrion are deflated. Larvae of Diptera form large masses of larvae on the carrion in this stage of decay. Smell of decay is very strong. These larvae utilized most of the carrion body and increased in size and number with time. A large number of beetles also start arriving on the carrion. In this stage the population adult Calliphorid and Sarcophagid insects are reduced (Goff, 1993).

Post-decay stage

The Coleopterans species are usually in greater number in this stage when the carrions are reduced to the skin, cartilage and bones. The larvae stopped feeding, leave the carrion and burrowed in soil (Tullis and Goff, 1987).

Dry stage

In this stage, the remains consisted of hair and bones only. Very little or no smell is observed in this stage. The skin beetles population reaches at peaked in this stage (Goff, 1993). A specific group of insects distinguish each stage of decomposition. Each group arrived at a specific time on the carrion and occupied a particular niche (Payne, 1965). Objective of present study to investigate insect fauna in district Peshawar for a case study by the use of forensic tools.

Materials and methods

Study Site

To study the insect succession on rabbit carrion, experiments were conducted at Agronomy Research Farm (ARF), The University of Agriculture Peshawar, during 2015.

Materials

The materials used in the experiments includes plastic jars, glass vials, forceps, petri dishes, insects pinning needles, scissor, gloves and mask, rubber bands, plastic trays (14″ × 10″), muslin cloth, insect's hand net, killing jars, meat, soil, ethyl acetate, 70 % ethyl alcohol and wooden cages (18″ × 18″ × 16″) were used.

Test Animal

Rabbit, *Oryctolagus cuniculus* L. was used as a test animal during the study.

Rabbits killing and field methodology

During the present experiment the rabbits were killed by intra cardiac injection and slaughtered with a knife. Immediately after death, rabbits were placed in wooden cages covered with welded wire gauze (0.78″ × 0.78″), that allow the entrance of carrions insects while prevent them from disturbances by the vertebrate scavengers (Wolff *et al.,* 2001). Each carcass was placed in the cage on a tray filled with soil. During the whole period of decomposition from fresh to last moments, the carrions were observed three times daily in morning, afternoon and evening throughout the experiment.

Samples Collection

Active flying insects such as blow flies, flesh flies and house flies were collected by hand net while the crawling insects, beetles, larvae and pupae were collected with the help of forceps from the carrion. The adult insects were killed in killing jar, and were then move to the labeled vials having 70 % ethyl alcohol.

Identification

The collected specimens were identified with the help of available literature of Almeida and Mise (2009), Lackner (2010), Ruzicka and Schneider (2011) and Akbarzadeh *et al.* (2015). Identification of insects was carried out at the Research laboratory of the Department of Entomology, The University of Agriculture, Peshawar. Specimens were observed under Nikon microscope with magnification up to 400X.

Depository

All the identified specimens were deposited in the Insect Museum of Entomology Department Khyber Pakhtunkhwa, The University of Agriculture Peshawar.

Results and discussion

Insect succession recorded on different decomposition stages of rabbit

Table 1 shows the insect succession recorded on different decomposition stages of the rabbit carrion killed by intra cardiac injection placed in sunny and shady environment while that of the rabbits killed by injection and slaughtered kept in sunny environment was found similar throughout the study period.

The decomposition stages recorded were fresh stage, bloating stage, decay stage, post decay stage and dry stage. Description of these stages was very much similar to that described by De Jong and Chadwick (1999). Each stage was found to be inhabited by specific insects group. In this study total 16 insect species representing 11 families and three orders i.e. Diptera, Coleoptera and Hymenoptera related with carrions were recorded throughout the decomposition period. These findings are parallel to the conclusion of Maramat and Rahim (2015) who also reported these three major orders during their studies.

The succession of insect in the sun and shaded areas generally followed the same pattern. However, the slaughtered and sun exposed carrion decomposed faster than the shaded and carrion killed through injection. These finding are comparable with those of Mabika *et al.* (2014). Insect succession occurred in an expected sequence; the Diptera were the first insects to colonize the carrion and the Coleoptera appeared later. Similar pattern of insect succession was recorded by Martinez *et al.* (2007) and Okiwelu *et al.* (2008).

Seven species of *Diptera* belonging to 3 families consisted of *Chrysomyam agacephala* (Fabricius, 1794), *Chrysomy aruffifacies* (Maquart, 1843), *Lucilia illustris* (Meigen, 1826), *Lucilia ampullacea* (Villeneuve, 1922), *Phormia regina* (Meigen, 1826) (Calliphoridae), *Sarcophaga* sp. (Sarcophagidae) and *Musca domestica* (Linnaeus 1758) (Muscidae).

Chrysomya magacephala and *Chrysomy arufifacies* were the main species recorded in greater number in fresh, bloating and decay then the other collected species in this study. The coleopteran fauna recorded during the study includes Histeridae, Cleridae, Scarabaeidae, Silphidae, Staphylinidae and Dermestidae. The beetles were observed from the late bloating stage and dominated the later stages of decomposition as concluded by Aggarwal (2005). The species involved were *Saprinus* sp. (Erichson, 1834) and *Gnathoncus* sp. (Jacquelin-Duval, 1858), *Necrobia rufipes* (De Geer, 1775), *Scarabaeid* sp., *Necrophil arufithorax* (Wiedemann, 1823), *Staphylinid* sp. and *Dermestesm aculatus* respectively. The red wasp and ants were belonging to order Hymenoptera. Ticks and spiders were also collected during the study. Similar findings were reported by Bharti and Singh (2003).

Among the dipterans, the families that occupied the carrion in the early stages of decomposition include Calliphoridae, Sarcophagidae and Muscidae (Grassberger and Frank, 2004).

Immediately following death, Calliphoridae and Sarcophagidae were the first insects to appear on the rabbit carrions and their number increases gradually with time. They deposited their eggs and first instars larvae on the carrion and utilized most of the flesh (Watson and Carlton, 2003; Kyerematen *et al.*, 2012). Calliphorid species play a very important key role in the carrion decomposition and were observed from the fresh stage to end of decay stage as reported by Wolff *et al.* (2001).

House flies (Muscidae) also arrived later in the fresh stage and were observed till decay stage but do not colonizing the carrion.

The dipteran adult flies were observed from the fresh stage up to the end of decay stage though less number of adult flies visiting the carrions was observed in the late decay stage than the earlier stages. The present study results are in correspondence with those of Bharti and Singh (2003).

Beetles (Coleoptera) were the most common adult insects observed from decay stage up to dry stage. Among the beetles, families such as Histeridae and Scarabaeidae were the first to arrive on the carrions in the late bloating stage, mainly feeding on larvae and were still observed in decay and post decay stages. Our results support the findings presented by Aggarwal (2005). *Necrobia rufipes* was the only species recovered from the carrion in decay and post decay stage and were feeding on maggots and as well as on the carrion. Similar observations have been made by Braack (1987). Families such as Silphidae and Staphylinidae were represented by *Necrophil arufithorax* and *Staphylinid* sp. Respectively and were found preying on larvae in decay and post decay stages as observed by other researchers such as Tantawi *et al.* (1996). During the post decay stage the skin beetles *Dermestes meculatus* was the important species and their greatest number was recorded in the dry stage. They were consuming the hairs, dried skin and the bones. Ants were present in all stages while spiders were recorded in the later stages. These results agree to the findings of the study that was carried out by Bharti and Singh (2003).

Table 1. Insects succession on rabbit carrion recorded on five decomposition stages during 2015.

Order	Family	Genus/species	Decomposition Stages of carrion				
			Fresh Stage	Bloating Stage	Decay Stage	Post Decay Stage	Dry Stage
Diptera	Calliphoridae	*Chrysomya megacephala*	+	+	+	–	–
		Chrysomya rufifacies	+	+	+	–	–
		Lucilia illustris	+	+	+	–	–
		Lucilia ampullacea	+	+	+	–	–
		Phormia regina	+	+	+	–	–
	Sarcophagidae	*Sarcophaga* sp.	+	+	+	–	–
	Muscidae	*Musca domestica*	+	+	+	–	–
Coleoptera	Cleridae	*Necrobia rufipes*	–	–	+	+	–
	Histeridae	*Gnathoncus* sp.	–	+	+	+	–
	Histeridae	*Saprinus* sp.	–	+	+	+	–

Order	Family	Genus/species	Decomposition Stages of carrion				
			Fresh Stage	Bloating Stage	Decay Stage	Post Decay Stage	Dry Stage
Coleoptera	Scarabaeidae	*Scarabaeid* sp.	—	+	+	+	—
	Silphidae	*Necrophila rufithorax*	—	—	+	+	—
	Staphylinidae	*Staphylinid* sp.	—	—	+	+	—
	Dermestidae	*Dermestes maculatus*	—	—	—	+	+
Hymenoptera	Formacidae	Ants	+	+	+	+	+
	Vespidae	Red wasp	—	+	+	—	—
	Spiders	Unidentified	—	—	+	+	+
	Ticks	Unidentified	—	—	—	—	+

+: Present in this stage; **—:** Absent in this stage.

Conclusion

Dipteran flies begin to visit the carrion a few moments after carrion exposure until late decay stage while the beetles dominated the later stages (decay to dry stage). The general patterns of insect succession were similar however differences were recorded in duration of the decomposition stages.

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