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Coleoptera species associated with dog (*Canis domesticus* L.) Cadever in tropical region of Mardan, Pakistan

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Abstract

Forensic entomology is the study based on the principal of ecological succession of insect's communities as biological indicators associated with the dead body for calculation of post mortem interval. In the present study, insect fauna identification in dead dog, *Canis domesticus* L. has been used as in substitute of dead human body in tropical region Mardan, a tool for forensic entomology were carried out in five different decomposition stages, fresh, bloat, active decay, advanced decay and dry. The collected *Coleoptera* species were *Dermestes maculates, Hister* sp., *Trox* sp. and *Necrobia rufipes*. *Dermestes maculates* was first arrived to dog carcass while *Hister* sp. adults and larvae dominated later stages of decomposition. The average temperature (28.3±1.8-40.4±1.7) was found to affect *Coleoptera* adults, larvae and rate of decomposition of *C. domesticus* during the observation period for 11 days. This research will be helpful for forensic entomologist for a case study of death to investigate the crimes in district mardan, Pakistan.

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Introduction

Forensic entomology is the study of insect's communities as biological indicators for the death of an organism. It is based on the principal of ecological succession of those insects which are associated with the body. These studies are usually related to suspected criminal, for the purpose of exploring information useful to an investigation (Smith, 1986; Byrd, *et al*., 2001; Ali *et al., 2013*). The time and arrival of insect colonies can be estimated in dead body (Greenberg, 1991). Insect life cycles begin within minutes of death which act as precise clocks (Catts and Haskell, 1990). Two time dependent processes for the calculation of death time period is involved in these studies. The first is the growth of insect larvae that feed upon the victim. Most of the carrion insects rarely deposit offspring on a live person, therefore, the age of a larva provides a minimum time since death. The second is the succession of carrion arthropod species found in the body, which has the potential of providing both a minimum and maximum estimated post mortem interval (PMI) (Greenberg and Kunich, 2002). Forensic entomological methods have been successfully applied in many cases, with the calculations of the PMI by entomological techniques fitting well with the time intervals established by other means (Smith, 1986; Goff *et al*., 1988). However, forensic entomology is highly accurate from 72 hours after death and in some cases the last method that can be used for making PMI estimations (Kashyape and Pillai, 1989). A definite ecological succession occurs among the insects communities on decomposing carcasses (Payne, 1965). Each stage of decomposition is characterized by a particular group of insects, each of which has a particular arrival, which allows it to occupy a particular niche (Payne, 1965). The existence of the arthropods in particular insects is facilitated by the protein rich carcass resources (Wells and Greenberg, 1994a). *Coleoptera* is the second decomposers, become the most important forensic indicators during later stages of decomposition, as they feed upon the skin and hairs (Lord, 1990; Boucher, 1997).

These include the beetles *Dermestes maculates* (Geer) of family Dermestidae, *Oxyletrum disciolle* (Zetterstadt) of family Silphidae, *Necrobia rufipes* (Fabricus) of family Cleridae and *Trox* sp. (Harold) (of family Troxidae), *Hister* sp. (Gullenhal, 1808), (of family Histeridae) (Boucher, 1997; Goff *et al*., 1986; Tantawi *et al*., 1997). These species can simply be using the carcasses as for life cycles, food and shelter. Adults of these flies use carrion for feeding, larvae a Beetle *Hister* sp. is dominated and responsible for the maximum consumption of terrestrial carrion (Payne, 1965; Putman, 1977; Braack, 1981; Putman, 1983; Braack, 1986; Early and Goff, 1986). Sasha *et al.* (2009) have examined the insect succession variations on the decomposing remains in two areas bush land and agriculture of western Australia, according to annual, seasonal and short term durations. Insect succession pattern were observed spatial and temporal scales multivariate analysis were done on occurrence based distance of bodies. Insect succession was noted according to time periods and locations. It was found insect assemblage were similar between same sites within the same geographic areas. The agriculture site missed some species that showed the difference. In bush land habitat three species of *Coleoptera* were identified that was darking beetles, *Ptomaphila lacrymosa* (Schreibers) of family Silphidae, *Omorgus tatei* (Blakburn) of family Trogidae and *Helea castor (*Pascoe) of family Tenebionidae that was the indicative in post mortem movement of the body in these two areas. Forensically important data of insect succession according to seasons were collected for western Australia. This study has focused parasitoids hymenoptera that parasites dipteral colonies. Parasitoids can be used for PMI time frame in cases for forensic indicators.

Szymon *et al.* (2008) observed insect succession and pig carrion decomposition in pine, Hornbeam oak forests and alder forest in western Poland at the end of summer and beginning of fall (2005). Observations were occurred in five stages of decomposition fresh stage, bloated stage, active decay stage, advanced decay stage and remains stage.

The highest decomposition rate was observed in the alder forest than in the pine oak forest. Similarity in carrion fauna was found in each forest. The beetles recorded from both of the forests were hairy rove beetles, *Thanatophilus rugosus* (Linnaeus) (of family Silphidae), *Creophilus maxillosus (*Linnaeus) of family Staphylinidae, rove beetles, *Oxypoda acuminate* (Stephens) of family Staphylinidae, *Omalium rivulare* (Paykull) of family Staphylinidae and *Philonthus* sp. (Stephen) of family Staphylinidae. There were no differences in the sequence of insect occurrence on carrion between the forests. The differences between forests in occurrence time and activity period of some taxa were observed. The objective of present research is to determine the usefulness and applicability of forensic entomology and investigate insect fauna in tropical region for a case study.

Materials and methods

In materials plastic jars, forceps, gloves, mask, insects net, digital camera and a wire gaze cage to cover the dead dog *Canis domesticus* L. were used. The dog was killed by through sharp long knife. The dog, *canis domesticus* was kept in open ground of Government Degree College, Takht Bhai, Mardan.

Observation

Trails for observations and collections of insects, larvae, pupae and adults were carried out daily in morning, afternoon and evening. This ensured that all type of insects were sampled as flies were active in later morning and beetles in evening time while larval growth was more rapid in noon. The wire gaze cage was removed aside at every sampling time and dog was not disturbed during this study. Trails were exercised to the period of total fleshy tissues of dog dead body exhausted (15-25 May, 2011 up to 11 days).

Data collection

Daily visits were done up to 11 days, three times in morning, noon and evening per day. Adults of beetles were collected larvae and pupae were crawling in nature appeared in each day were collected through forceps from the carcass into the plastic jars for preservation and jars were labeled.

A wire gaze cage (x 36″× y 54 × z 32″) was used to keep the carcass. A 5 kg stone was also used to safe the dead dog from other living scavengers. Each day insects were put into separate jars. Forensic insect's identification methods of insects were used (White *et al.*, 1940; Dodge, 1953; Seago, 1953; Furman and Catts, 1982; Wells *et al.*, 1999).

Results

For this study Decomposition of *C. domesticus* dead body was divided into five stages as fresh, bloated, active, advanced and dry. Fresh stage was the first day continued for 0-12 hours after death. In this stage body structure was in original form except of dead and no smell was observed. The outside appearance of the bodies was similar to those of live dogs. No coleopteran species were observed in this stage. Bloated stage was second stage recognized that the body of dog emitted very strong smell that was highest than the first day and is the characteristic feather of bloat stage of decomposition. *Canis domesticus* abdomen became scratched and blackened. This stage started from 1st day evening of death up to third day morning (13-48 hours.), i.e, (36 hours.). Active decay comprised the third stage the skin of the *C. domesticus* was appeared blacken, emitted less smell and 80-90% of the body was decomposed. There were traces of flesh present on ground side of the body. The total duration of this stage was 3-4 days after death (49-96 hours.). Advanced Decay Stage this stage was 5-6 days after death (97-144 hours.) was characterized by minor deep odor and the removal of the soft internal tissues. The body was decomposed up to 90-99%.

Dry stage this stage took five days 7-11 (145-265 hours.) of decomposition. The smell was very minor or absent. There were minor traces of skin and hairs in first two days of this stage, but after that the bones were totally exposed. There was no *coleoptera* species present in this stage.

Hide beetle, Dermestes maculates (Geer, 1774)

Dermestes maculatus is belonging to order, Coleoptera and family, Dermestidae. This beetle was first time found at evening, because of nocturnal in behavior on first day of active decay stage 47 hrs. later

of death and were present in huge number on second day evening of active decay stage, while present up to early decay stage and was completely absent advanced decay and dry stage . Their activities occurred at evenings, while ate on hair and skin (Fig. 1b).

Table 1. The *Coleoptera* species classification into order, family, genus and species of dog, *Canis domesticus* L. carcass observed during five different decomposition stages noted during the present research in May 2011 in Takht Bhai, Mardan.

Order	Family	Genus/Species
Coleoptera	Dermestidae	*Dermestes*
	Histeridae	*maculatus*
	Cleridae	*Hister* sp.
	Trogidae	*Necrobia rufipes*
		Trox sp.

Table 2. The *Coleoptera* species associated with dog, *Canis domesticus* L. carcass observed during five different decomposition stages noted during the present research May 2011 in Takht Bhai, Mardan.

Scientific names	Stages of Decaying *Canis domesticus*				
	Fresh (12 h)	Bloated (36 h)	Active (3-4 days)	Advanced (5-6 days)	Dry (7-11 days)
Dermestes maculatus	A*	A*	P*	A*	A*
Hister sp.	A	A	P	P	P
Necrobia rufipes	A	A	P	P	P
Trox sp.	A	A	P	P	P

P*: presence in this stage; A*: absence from this stage.

Fig. 1. Following *Coleoptera* species associated with dog, *Canis domisticus* L. carcass during this study in May, 2011 in Takht Bhai, Mardan has been given a: Clown beetle, *Hister* sp. (Gullenhal); b: Hide beetle, *Dermestes maculates* (Geer); c: Skin beetle, *Trox* sp.(Harold); d: Ham beetle, *Necrobia rufipes* (Fabricus).

Clown beetles, Hister sp. (Gullenhal, 1808)

Hister sp. is belonging to order, Coleoptera and family, Histeridae. This beetle was first time noted after *D. maculates* in 10 minutes (47 hrs. and 10 min) after death of the body in evening i.e. was arrived in active decay. As this beetle was present in all later decay stages than. *Hister sp*. like other beetles was nocturnal and ate on skin and hair of *C. domesticus* (Figure 1a).

Ham beetle, Necrobia rufipes (Fabricus, 1781)

Necrobia rufipes is belonging to order, *Coleoptera* and family, Cleridae. This beetle was first time noted on 2nd day evening of active decay stage of decomposition (71 hrs.) after death. The reached to maximum within 15 minutes. More consisted than other species and active both in day and night times. It was also noted that members of this species was present in advanced decay and dry stages of decomposition (Figure 1d).

Skin beetle, Trox sp. (Harold, 1872)

Trox sp. is belonging to order, *Coleoptera* and family, Trogidae. This was last species of all beetles above on

the first day evening of advanced decay 81 hrs. after death. Their numbers reached to maximum within one hour. These beetle adults were present up to the 3rd day dry stage on exposed bones, while in later 2 days in decay stage was absent (Figure 1c, table 1 and 2).

Discussion

D. maculates belongs to family Dermestidae, moreover, species *Hister* sp. belongs to family Histeridae, futher, species *N. rufipes* belongs to family Cleridae, furthermore, species *Trox* sp. belongs to family Trogidae. In this study, *Dermestes maculatus* was first arrived to *C. domesticus* carcass while *Histers* sp. adults and larvae numbers were dominated in active, advanced decay and dry stages of decomposition. This research also showed deviation from below studies that *Histers* sp. would be helpful for later time duration estimation of dead body in tropical region of Pakistan.

Carvalho *et al.* (2000) reported in the study of insects succession on carcass in Brazil. They reported 3 species belonging to 3 families i.e. *D. maculates* and *Oxyletrum* disciolle (Brullé), were belonging to families of Dermestidae and Silphidae, furthermore, *N. rufipes* was belonging to family Cleridae. The adults and larvae of *D. maculates* was dominated in later stages of decomposition. Sasha *et al.* (2009) have examined the insect succession variations on the decomposing remains in two areas bush land and agriculture of western Australia. Three species of *Coleoptera* were identified that was darking beetles, *Ptomaphila lacrymosa* (Schreibers) (of family Silphidae), *Omorgus tatei* (Blakburn) (of family Trogidae) and *Helea castor* (Pascoe) (of family Tenebionidae) that was the indicative in post mortem intervals of later stages of decompositions. Szymon *et al.* (2008) observed insect succession on pig carrion decomposition in Poland. They collected the beetles Hairy rove beetles, *Thanatophilus rugosus* (L.) (of family Silphidae), *Creophilus maxillosus* L. (of family Staphylinidae), rove beetles, *Oxypoda acuminate* (Stephens) (of family Staphylinidae), *Omalium rivulare* (Paykull) (of family Staphylinidae) and *Philonthus* sp. (Stephen) (of family Staphylinidae). *Oxypoda acuminate* and *Philonthus* sp. Adults and larvae were more abundant in later stage of decomposition. Kimberly *et al.* (2005) observed insect fauna succession pattern pig cadaver in south-west Virginia. Trails for collection of *coleoptera* species were done in 2001, 2002, 2003, three hairy rove beetle.

Creophilis maxillosus L. (of family Staphylinidae), *Platydracus maculosus* (Kraatz) (of family Staphylinidae) and *Aleochara lata* (Gravenhorst) (of family Staphylinidae) and three margined carrion beetle, *Oiceoptoma noveboracense* (Farster) (of family Silphidae), *Necrodes surinamensis* (Fabricius) (of family Silphidae), and *Necrophila Americana* (L.) (of family Silphidae) respectively. The *Creophilis maxillosus* and *A. lata* adults and larvae have important forensic indicators of later stages of decompositions.

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