PRELIMINARY CHECKLIST OF BEETLES ASSOCIATED WITH PIG CARRIONS DECOMPOSITION IN OKIJA, ANAMBRA STATE, NIGERIA

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ABSTRACT

The study to ascertain the beetles associated with decomposing pig carrions in Okija, Anambra State, Nigeria was carried out in an open fallow plot (05° 53.24° N and 006°48.5° E) within the ambient temperature and relative humidity of 30.2 ± 0.28 °C and 68.5 ± 1.34 % respectively. The beetles found on the decomposing carrions were collected with blunt forceps and handpicked. They were preserved in a 70% ethanol and morphologically identified by a taxonomist. The beetles consist of seven families; Chrysomelidae, Dermestidae, Staphylinidae, Cleridae, Carabidae, Scarabaeidae and Histeridae, ten species - Buphonella sp., Dermestes frischii (Klug.), Ocypus raffrayi (Fauvel), Necrobia rufipes (Deg.), Necrobia ruficolis (Fab.), Angionychus lividus (Klug.), Zophosis sp., Gymnopleurus sp., Hypocacculus sp. and Hister sp. The arrival of the beetles was predictable and decomposition stage dependent. Their activities on the decomposing carrions include consumption of the carrion tissues and predating on other carrion insects. Thus, Buphonella sp., Dermestes frischii, Necrobia rufipes, Necrobia ruficolis, Ocypus raffrayi and Hister sp. were referred to as beetles of forensic importance, while the other beetles collected were grouped as either predator of the carrion feeders and/or opportunists on the carrions resource.

Keywords: Beetles, Chrysomelidae, Dermestidae, Staphylinidae, Cleridae, Carabidae, Scarabaeidae, Histeridae, Pig carrions, Decomposition, Forensic, Okija

INTRODUCTION

A dead body attracts a wide variety of insects which use the corpse for food and as a place to lay eggs for development of new progeny. Beetles are among the variety of the insects found on decomposing carrions. They, belong to the order Coleoptera and all, share features in common. They have biting mouthparts or mandibles, their antennae characteristically have eleven segments and the thorax (prothorax) is usually distinctive in shape and size and can be used as a means of identifying the beetles (Gennard, 2007).

Studies relating to forensic entomology centres on insects associated with decomposing carrions of different origins. Thus, pig carrion is one of the most common animals used (Gill, 2005) and as a model for human corpse (Catts and Goff, 1992) and because pig is considered biologically similar to human. It is the preferred model for forensic entomology research on succession in humans, where human cadavers are not used or for legal reasons or cannot be used (Gennard, 2007).

Successional changes in insect fauna on the corpse have been noted and related to the stages of decomposition through which the body passes. Beetles are mainly the group of insects that succeed the flies either during the bloating or during the wet and dry decay stages. They usually arrive on the carrions few days after death to feed on the soft and dried tissues of the carrions (Abajue *et al*., 2013) and as well feed on the fly larvae (Grassberger and

Frank, 2004). The presence of beetles as well as their larvae and their molted skins found on a corpse or exposed animal carcass can offer forensic entomologist the possible estimation time of death or the post mortem interval (PMI) of the corpse or the carrion. Thus, forensic entomology is geared towards estimating the time since death of an individual and possibly elucidating the circumstances that led to the death of the individual especially in homicides, using insects recovered on the corpse or at the death scene, in the law court.

Hence, the need to identify the beetles of forensic importance has become inevitable as an entomological tool in estimating PMI in homicide investigations in Nigeria. This will assist law enforcement agencies and medical coroners in consolidating their findings especially when the corpse has taken some days and decomposition stage advanced beyond the validation of medical pathologists.

Therefore, to provide valuable information such as the PMI of an individual which have taken days or months, requires a study of beetles consistently found on carrions to estimate their post mortem interval. This is one of the reasons that necessitated the study in Okija, Anambra State, Nigeria using pig carrion as a model to human corpse. The study however, carefully recorded the arrival time of the beetles and their functional roles on the carrions.

MATERIALS AND METHODS

The study was carried out between January and May, 2012 in an open fallow plot; 05° 53.24° N and 006°48.5° E in Ubahueze-Ihite, Okija. Okija is a town in Ihiala Local Government Area of Anambra State, Nigeria (Figure 1). The vegetation in Okija is derived tropical savanna with patches of forest and palm trees. The topography is a combination of high and lowlands with Umuhu and Ihite villages constituting the lowlands. The temperature in Okija ranges from 26 to 30 °C with wet and dry seasons in a yearly cycle (Okija In-Home, 2010).

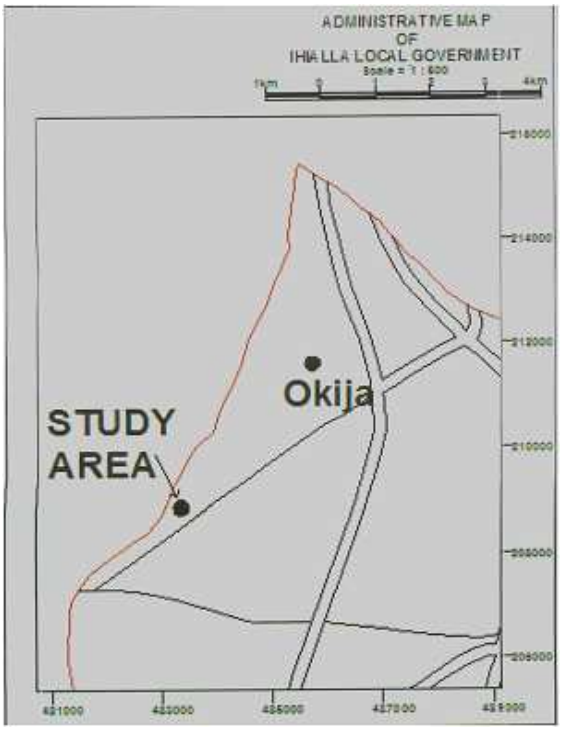

Figure 1: Map showing Ubahueze-Ihite Okija in Ihiala Local Government Area, Anambra State, Nigeria (Okija-in-Home, 2010)

Experimental Animal: Six healthy white pigs (*Sus scrofa* Linn.) with mean weight of 24.8 ± 0.9kg were used as recommended by (Catts and Goff, 1992) as a model for human corpse. The pigs were purchased from a piggery in Umuogu, Okija. They were killed by 06 hours 30 minutes in the morning, washed with clean water and transported immediately to the fallow plot in polyester sacks. The six pigs were divided into two groups. Each group of three pigs was deposited three metres apart and five metres apart between the groups. The pig carrions were guarded against vertebrate scavengers with wire mesh that permits entrance of all insects and other arthropods. The wire mesh was used to form cylindrical cages (height 83 cm and diameter 80 cm) supported with cement blocks.

Insect Collection: Before daily collection, the decomposition state of the carrions was noted. The cages and the cement blocks were set aside so that the beetles on the carrions can easily be collected with a pair of blunt forceps or handpicked and preserved in a 70% ethanol.

Table 1: Beetles collected on the decomposing pig carrions from January to May, 2012 in Okija, Anambra State, Nigeria

Family	Species
Chrysomelidae	*Buphonella* sp.*
Dermestidae	*Dermestes frischii (*Klug.)*
Staphylinidae	*Ocypus raffrayi* (Fauvel)*
Cleridae	*Necrobia rufipes (*Deg.)*
	*Necrobia ruficolis (*Fab.)*
Carabidae	*Angionychus lividus* (Klug.)
	Zophosis sp.
Scarabaeidae	*Gymnopleurus* sp.
	Hypocacculus sp.
Histeridae	*Hister* sp.*

**Beetles of forensic importance*

Table 2: Beetles succession on the decomposing pig carrions in Okija, Anambra State, Nigeria

Conditions of the body	Insect taxa
Fresh	Staphylinidae
Bloated	Dermestidae, Cleridae, Chrysomelidae, Carabidae, Histeridae
Active decay	Dermestidae, Cleridae, Chrysomelidae, Histeridae.
	Dermestidae, Cleridae, Chrysomelidae, Histeridae, Staphylinidae
Dry decay	Cleridae, Chrysomelidae, Carabidae, Scarabaeidae, Histeridae

They were later sorted into their taxonomic group in the Zoology Laboratory, Nnamdi Azikiwe University, Awka. Samples of the taxons were sent to a taxonomist at Insect Museum, Institute of Agricultural Research, Ahmadu Bello University, Zaria for the species identifications. The temperature and relative humidity of the study site was obtained with a portable thermo-hygrometer (Mextech model).

RESULTS

Beetles found and collected on the decomposing pig carrions belonged to seven families of Coleoptera; Chrysomelidae, Dermestidae, Staphylinidae, Cleridae, Carabidae, Scarabaeidae, Histeridae and ten species (Table 1).

The beetles were found to occur in succession according to the decomposition stages of the carrions (Table 2). *Ocypus raffrayi* was the first and the only beetle collected during the fresh stage, while *Dermestes frischii*, *Necrobia ruficolis*, *Necrobia rufipes*, *Buphonella* sp. Angionychus *lividus*, *Zophosis* sp. and *Hister* sp. were collected during the bloating stage. *Dermestes frischii*, *Necrobia ruficolis*, *Necrobia rufipes*, *Buphonella* sp. and *Hister* sp. were also collected during the active decay stage. During the dry decay stage, *Dermestes frischii*, *Buphonella* sp. *Ocypus raffrayi, Necrobia rufipes, Necrobia ruficolis, Angionychus lividus*, *Zophosis* sp. *Gymnopleurus* sp. *Hypocacculus* sp.and *Hister* sp. were collected.

The daily mean ambient temperature and relative humidity of the study site through out the study period were 30.2 ± 0.28 ^{o}C and 68.5 ± 1.34%, respectively.

DISCUSSION

The decomposition process of the pig carrions was studied in an uncultivated open fallow plot. The daily ambient temperature and the relative humidity of the plot were not entirely different from the environmental conditions peculiar to the tropics, which accentuated diversity of the beetles. Hence, the family Dermestidae collected was *Dermestes frischii*. The beetles in this family are well known to feed on the dry skin and bones (Payne and King, 1970) and Putman (1977) considered them as true carrion feeders, playing important role in carrion degradation. Catts and Goff (1992) in their respective investigations on forensic entomology in criminal cases and estimation of post mortem interval using arthropods development and succession pattern have stated that dermestids have the potential to offer investigators an estimation of the time since death in homicide or questionable cases. They also observed that similar to the use of flies in forensic entomology, the arrival of dermestids to carcasses occur in a predictable succession. Richards and Goff (1997) reported that adult of dermestid beetles generally arrive 5 to 11 days after death. This assertion was in accordance with the report of Ekrakene and Iloba (2011) as they observed

arrival time of 5 to 10 days after death. This study observed 3 to 4 days after deposition. Dermestids was one of the most abundant beetles during the dry decay stage as the adults and larvae were involved in the consumption of skins left from previous decay stages. The beetles have been reported in previous studies as forensic insects (Benecke, 1998; Greenberg and Wells, 1998; Bharti and Singh, 2003).

Similarly, *Necrobia ruficolis* belonging to the family Cleridae and *Buphonella* sp. in the family Chrysomelidae were collected on day four, the peak of the bloating stage of the carrions while the *Necrobia rufipes* also in the family Cleridae was collected on day five, the onset of the active decay stage. Ekrakene and Iloba (2011) similarly observed *N. rufipes* during the early wet decay stage of decomposition. The arrival of Chrysomelidae and Cleridae during the bloated decay stage was also observed by Ekanem and Dike (2010). These species were predominantly found in the regions of the carrions that have achieved high level of dryness. Though, *Buphonella* sp. and *Necrobia rufipes* were continuously found on the carrions throughout the study period, while *Necrobia ruficolis* was not found all through but is one of the clerid beetles mostly reported to associate with carrion decomposition in the developed countries (Aggarwal, 2005) and have been reported as forensic insect too (Lord, 1990; Goff and Odum, 1987; Bharti and Singh, 2003). *Necrobia ruficolis* may be used also as forensic insect of this region as it shared the same features and characteristics with *Necrobia rufipes* as observed in this study.

Other beetles such as *Hister* sp., *Hippocacculus* sp. (Histeridae) and *Ocypus raffrayi* (Staphylinidae) collected in the study were predating mainly on the fly larvae found on the carrions. Their arrivals on the carrions were predictable and have defined roles thus, been included as insects of forensic importance. *Angionychus lividus*, *Zophosis* sp. (Carabidae) and *Gymnoplerus* sp. (Scarabaeidae) have no specific roles and predictable time of arrival on the carrions; hence they were not referred to as forensic insects. Thus, they could probably be referred to as opportunistic beetles that may assist in defining the biogeoclimatic nature of the study area.

Conclusion: The findings of the study have led to the conclusion that beetles are important group of insects in the decomposition of carrions. The dermestids, clerids, chrysomelids, histerids and staphylinids collected in this study can offer forensic investigators on homicides in this region, the estimated time that has elapsed prior to the discovery of a corpse, if the natural decomposition process was not altered as well as offer clue as where the corpse was found or deposited.

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