A PRELIMINARY STUDY OF INSECTS ASSOCIATED WITH SURFACE RABBIT CARRIONS IN WARRI, DELTA STATE, NIGERIA

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Abstract: The preliminary survey of the entomofauna on decomposing carrions in Warri was undertaken to provide a baseline insect information on carrion decomposition. Seven rabbits (*Orytctolaguscuniculus*) of mean weight 2.14±0.12kg (M±S.D) sacrificed by cervical dislocation were monitored for 45 days from January, 7th and February 21st, 2017 with daily observation and collection of invading insects. The results obtained revealed four (4) identifiable stages of decomposition (fresh decay, bloated, wet decay, and dry decay) even though the entire decomposition process was a continuous one. Insect species from three (3) Orders i.e. Diptera, Coleoptera and Hymenoptera and fourteen families were consistently sampled. Most species from Diptera and Coleoptera were of forensic importance as they used the carrions as breeding ground thus providing a biological tracking template for a possible estimate of time since carrions were killed or exposed. The Hymenopteran species were mainly opportunistic, as they used carrions for food and temporary shelter. It is suggested that further work be carried out within the Warri metropolis and other areas in order to obtain all likely insects of forensic importance unique to the areas.

Keywords: Arthropods, carrions, decomposition, forensic entomology, Warri

Introduction

The empirical studies of insects involved in decomposition have become very essential because of the significant role insects play in investigation relating to crime and criminality, especially those connecting to murder and homicide. Insects, being highly diverse creatures both in forms and number have influenced the whole system of life on earth. They contribute very immensely to the continuity of the earth through the mechanism of pollination in plants; decomposition of plants and animal remains thus recycling nutrients among others (Aggarwal, 2005; Ekrakene and Iloba, 2011). Arthropods that feed on dead vertebrate bodies including man and other animals (carrion feeders) make them significantly important in forensic science (Ekrakene and Iloba, 2011). Forensic entomology is concerned with the arthropods involvement in the events surrounding felonies or crimes (Okiwelu*et al.*, 2013). Many factors and processes affect the application of different species of insects and other arthropods in forensic entomology especially in the determination of Post Mortem Interval (PMI). Micro and ambient climatic factors, differences in geography and topographic locations, cues for attraction and competition among species of insects are some of the factors that influence the succession of insects to carrion (Abell*et al.*, 1982; Blackit and Blackit 1990; Ekrakene and Iloba 2011; Okiwelu*et al*., 2013; Abajue*et al*., 2014; Ewuim and Abajue, 2016).

The elementary fauna concerned with decomposing animal carrions are insects. They are assumed to be the most significant in the organic materials recycling back into the ecosystem; they are in the order of Diptera and Coleoptera and are the most significant and plenteous species that are associated with the decomposition of carrions. Some species of these groups of insects are referred to as necrophagous and responsible for the decomposition of the animal cadavers (Okiwelu*et al.*, 2013). Anderson (1995) opined that Insect succession varies from geographic region to region and the species and time of colonization must be developed for all areas. In view of the concept of variation in insect species from region to region, this research work is undertaken as an initial study on the insects associated with decomposing carrion in Warri, Delta State, Nigeria. Globally, the study and practice of forensic entomology has in the last decade been highly expanded. In Nigeria, full-blown forensic entomology work did not start in Nigeria until 1988 (Ekanem and Usua, 1997). Despite the studies already done, Usua (2007) believes that studies in forensic entomology are still in infancy stage. With this in mind, attempt must be made to cover all regions and localities, hence the justification for this preliminary investigation.

Materials and Methods

The experimental site

The experimental site was located at the Biological Science Departmental farm of the College of Education Warri, Warri South Local Government Area, Delta State, Nigeria. The study was carried out between January, 7th and February 21st, 2017 in an open fallow plot of the farm. The college is located in Warri on Latitude 5º54'N and Longitude 5º73'E at an elevation of 21 m. It has a tropical climate characterized by two distinct seasons; the wet season occurs between April and October with a break in August. The dry season lasts from November to April with a cold harmattan between December and January. Temperature ranges from 32 to 37^{O}C, with mean annual rainfall of 2673.8 mm. The natural vegetation is rainforest and it is rich in timber tree, and other flowering plants (Egborge, 1994). The research area lies east of a botanical farm and southeast by a plantation orchard and surrounded by other research crop plants. Grasses, wildflowers, herbs, and weeds cover the field. The area approximated 50 × 150m. This size of land is to reduce overlapping olfactory cues.

Experimental animal, method of sacrifice and experimental layout

Three healthy rabbits (*Orytctolaguscuniculus*)with mean weight of 2.14±0.12 kg (Mean±S.D) were bought from Ogbuwangue market, along Nigerian Port Authority (NPA) express road, Warri in Warri South Local Government Area of Delta State.

The rabbits were sacrificed by cervical dislocation and were placed into heavy thrash bags and carried from the sacrificing Centre to the study Centre. They were guarded against vertebrate scavengers with wire mesh that permits entrance of all the insects and other arthropods. The wire mesh size of 160 × 100 × 30 mm was used to form cylindrical cages of height and width of 30 and 20 cm, respectively supported with iron

cage for each rabbit's carrion to protect the carrions from vertebrate scavengers. An inter carcass distance of at least 40 m was maintained to minimize interruption of flies from colonies.

Insects identification

The insects identification to genus and species levels were done with the keys in Shumar *et al*. (1990); Shumar and Mohammed (1989) and Shumar and Mohammed (1983), respectively.

Insects sampling and data collection

Entomofauna were collected two times per day at 10.00 and 14.00 GMT for the initial week, while once daily for the remaining weeks to ensure that all species of insects were sampled in accordance with insects activity (Slone *et al*., 2005). The experiment started on January 7th and lasted till 23rd February 2017. Insects were collected manually through the use of hand and sweep nets for flying insects, brushes and hand picking were manually used, for crawling insects while the soil just under the decomposing carrions were always scanned to collect any stage of insect found pupating or hiding around.

Second instar larvae were collected from each decaying carrion and bred in transparent plastic containers with depth of 15 cm and width diameter of 11.5 cm at 25.06±0.12^{o}C. Each breeding unit contains saw-dust and part of the decaying carrion-remains to feed the immature insects. Breeding containers were covered with muslin cloth, and rubber bands to permit ventilation and to prevent the escape of the insects (Ekrakene and Iloba, 2011). Containers of live maggots were monitored in the laboratory daily at prevailing temperatures of 28±2^{o}C.

Results and Discussion

Stages of decomposition and insects' succession

In the course of this investigation, four distinct stages of decomposition were identified even though the entire decomposition process was a continuous one. The stages of decomposition observed are described below and details of invading insects are presented in Table 1.

i. **Fresh decay stage:** This stage of decomposition lasted from 0 h i.e., the very moment of death till 36 hours to 2 days. There were no observed physiological or morphological changes physically on the decaying carrions. The first waves of insects to invade the carrions were members of the Dipterans, just few minutes after death. They include members of the Muscidae and Calliphoridae families invaded and laid eggs in batches at various orifices. Other insects observed at this are members of Formicidae family.
ii. **Bloated decay Stage:** This decomposition stage lasted from 36 h to 4 days with obvious physiological and morphological changes: swelling, seeping of fluid from orifices and odour are characteristics of this stage of decomposition. The significant insect groups here were larvae of members of Dipterans mainly in their first and second instar larvae together with adult Hymenopterans.
iii. **Wet decay stage:** this decomposition stage was characterized by very strong stench/odour, decomposing tissues have completely collapsed, carrions become very highly fluid and watery, hence wet day stage. The stage of decomposition lasts from 4 days to about 15 days or even more. Most Dipterans found at this stage are in their larvae form. Fewer adult Dipterans here compared to the two earlier stages. Hymenopterans especially members of Formicidae and Apidae families were also noticeable at this stage of decomposition. Few adult members from the Order Coleoptera were observed at this stage. The wet decay stage harboured most number of insects in the entire decomposition process, and it corresponds to the second wave of insect succession. The conclusive state of this stage of decomposition ended with the 3rd instar larvae migrating away from the carrions i.e., the pre-pupal stages of most of the Dipterans as general dryness of the carrions remain become obvious.
iv. **Dry decay stage:** Decomposition at this stage was observed from about day 20 and lasted beyond day 45. The predominant insect order here was the Coleoptera and the Hymenoptera. The Coleopterans were represented by the members of Dermestidae, Cleridae and Histeridae families. Also very significant at this stage were the empty puparium of Dipterans that littered around the remains and their immediate vicinity. It was also observed that the Coleopterans were present as adults and larvae suggesting that, they may have been developed from the process.

Table 1: Insect fauna at fresh and bloated stages of carrion decomposition

Decomposition stage of carrion	Duration	Insect Order	Family	Genus/Species	Insect stage likely to be present
Fresh Decay	36 h to 2 days	Diptera	Muscidae	*Muscadomesica*	Adult and Egg
				Haematobiaminuta	Adult and Egg
			Calliphoridae	*Luciliasericata*, *ChrysomyaalbicepsCalliphoravomitoria*	Adult and Egg
			Sarcophagidae	*Sarcophagaspp*	Adult and Larva
		Hymenoptera	Formicidae	*Myremecaris*spp	Adult
Bloated	2 to 5 days	Diptera	Muscidae	*Muscadomesica*	Adult and Larva
				Haematobiaminuta	Adult and Larva
			Calliphoridae	*Luciliasericata*, *ChrysomyiaalbicepsCalliphoravomitoria*	All are Adults and Larvae
			Sarcophagidae	*Sarcophaga*spp	Adult and Larva
			Fanniidae	*Fanninaspp*	Adult
			Drosophilidae	*Drosophiliaspp*	Adult
			Stratiomydae	*Hermatiaillucens*	Adult
		Hymenoptera	Formicidae	*Myremecaris*spp	Adult
		Coleoptera	Cleridae	*N. rufipes, N. ruficolis*	Adult
			Dermestidae	*Dermestismaculatus*	Adult

Table 2: Insect fauna at wet and dry decay stages of carrion decomposition

Decomposition stage of carrion	Duration	Insect Order	Family	Genus/Species	Insect stage likely to be present
Wet/Active	4 to 15 days or more	Diptera	Muscidae	*Muscadomesica*	2nd and 3rd instar Larvae
				Haematobiaminuta	2nd and 3rd instar Larvae
			Calliphoridae	*Luciliasericata, ChrysomyiaalbicepsCalliphoravomitoria*	All species in 2nd and 3rd instar Larvae
			Sarcophagidae	*Sarcophaga*spp	2nd and 3rd instar Larvae
			Fanniidae	*Fanninaspp*	Adult
			Stratiomydae	*Hermatiaillucens*	Adult and Larvae
		Hymenoptera	Formicidae	*Myremecarissenaarensis*	Adult
		Coleoptera	Cleridae	*Necrobiarufipes,*	Adult
			Dermestidae	*Dermestismaculatus,*	Adult and larvae
			Histeridae	*Hister*spp	Adult
			Staphylinidae	*Philonthus*spp	Adult
			Scarabeidae	*Onthophagus*spp	Adult
			Silphidae	*Nicrophorous*spp	Adult
Dry Decay	Beyond 20 days	Coleoptera	Cleridae	*Necropiarufipes, Necrobiaruficolis*	Adult
			Dermestidae	*Dermestismaculatus*	Larvae
		Hymenoptera	Formicidae	*Myrmicaris strata*	Adult
		Diptera	Calliphoridae	*Chrysomyaalbiceps*	Adult
			Stratiomydae	*Hermetiaillucens*	Larvae
			Sarcophagidae	*Sarcophagaspp*	Adult
			Muscidae	*M. domestica; H. minuta*	Adult

A lot of insect activities begin as soon as death of animal occurs. Mearns (1939) had noted that eggs of visiting insects are laid soon after death. Climatic weather conditions and geographical locations are among the factors that determine insects' species that invade carrions (Okiwelu*et al*., 2013). In this preliminary research work on insects associated with surface carrions in Warri, Delta State, Nigeria, insects from three orders, fourteen families and twenty species were sampled. The insects Orders are Diptera, Coleoptera and Hymenoptera. The colonization of the carrions by insects started with members of the Dipterans followed by the Coleopterans with the Hymenopterans being passively present at all times. This order of colonization observed is in line with what have been established both locally and internationally by previous researchers in the field of forensic entomology such as by Richard and Goff (1997), Greenberg and Well (1998), Benecke (1998), Anthon *et al.* (2011), Ekrakene and Iloba (2011), Okiwelu*et al*. (2013), Sanaa*et al*. (2013), Abajue*et al.* (2013).

The insects involved in the carrion decomposition could be classified according to the respective roles that they play in the process of decomposition, while some are active, others are passive hence they take advantage of the carrion for different purposes. According to Keh (1985) and Okiwelu*et al*. (2013), they could be grouped as predators, parasitoid, necrophages, cryptozoic and opportunists. While members of the Hymenopterans are mainly opportunistic, most species of Dipterans and Coleopterans involved in this process have been previously considered as forensically important insects (Tantawi 1996; Galal*et al*., 2009; Okiwelu*et al*., 2013; Ewuim and Abajue 2016) and have been so used to solve medicolegal matters. The forensically important insects either undergo full or part of their developmental stages within the decomposition process thereby fitting as a 'biological clock' or providing clues to what the cause of death probably is, as they could ingest toxicants contained in carrions. Hence, understanding the full decomposition process, and the array of insects connected therewith is an advantage to any jurisprudence.

Conclusion

The preliminary entomofauna collection on decomposing carrions from Warri, Delta State, Nigeria's South-South geopolitical zone is primarily similar to the insect groups already established locally and internationally. Insect species from the Orders of Diptera and Coleoptera were of forensic importance while species from the Order Hymenoptera were mainly opportunistic and cryptozoic. More researches are however needed to establish a more detailed insect's successional profile on carrions in the Warri axis. This would among other things enhance forensic entomology data base in Nigeria generally and the locality in particular.

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