IJABR Vol. 10(2): 41- 50 (2019)

Original article

EFFECTS OF MODE OF KILLING ON THE SPATIAL SUCCESSIONAL PATTERN OF FORENSICALLY IMPORTANT INSECTS IN MINNA

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Submitted: October, 2019; Accepted: November, 2019; Published: December, 2019

ABSTRACT

The successional pattern of insect at a cadaver is a key feature in the estimation of the minimum post-mortem interval which is the most widespread contribution of forensic entomology, the decomposition process of 12 pigs carcass (*Sus scrofa L*) with a mean weight of 23.24 $\pm$1.33kg sacrificed through three methods (stabbing oxygen deprivation and zinc phosphate) were monitored throughout the rainy season of 2013/2014 and 2014/2015 seasons at Niger State College of Education (COE) and Dutsen Kura water board supply unit (DK). There was no significant difference ($P>0.05$) between the arrival times and duration of stay between the two study sites but there exist significant variation ($P\leq0.05$) among the methods of killings. A consistent successional pattern of insect was observed irrespective of the study site, through the consistent insect from the earliest arrival to the latest arrival for oxygen deprived and stabbed pig carcasses was *Musca domestica* (5.00 to 5.50), *Lucilla sericata* (41.50 to 59.00 1minutes) *Chrysomya albiceps* (57.50 to 73.50 minutes) *C. rufaficies* (59.50 to 73.00 4.24), *Hermipyrellia Liqurriens* (5.00 to 5.50 hours), *Sarcophaga carnaria* (1.00 to 2.00 days), *Ophyra aenacens* (3.00 days), *Hermitia illucens* (3.00 to 3.50) and coleopterans (5.50 to 6.00 days). The insect in the order calliphoridae stayed on the carcass at the range of (9.00 to 10.00 days) Muscidae (16.50 to 17.00 days) and coleopteran (22.00 to 57.50 days). The pigs sacrificed by poisoning only with witnessed the presence of *musca domestica* and *lucilla sericata* at (4.50 to 5.50 hours) and 7.00 to 7.00 hours respectively. The findings of this study suggested that the successional pattern of forensic insects in the two sites in Minna is sequence and can be used to predict post mortem interval (PMI) and can also serve as a database information for future forensic research in Niger State.

Keywords: Insects, Carcass, Poison, Killing, Spatial.

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INTRODUCTION

Humans are less than unimportant life form on earth when compared to insects because insects rule in each and every sense of meaning [1]. Insects are the consumers of plant, major predators of plant eaters, play a major role in decaying of organic matter and decomposition of carcass and also serve as food for other animals [2]. There are many signs that leads us to the truth, they are there for us to search for them and fulfill for the requirement of causes and this is when the world will open its mysteries to us [3] , considering this and the fact that insects are always the first invertebrate to reach a carcass in a successive pattern and oviposite on it within few minutes enable us to use the understanding of life stages and behaviors of insects in medico-legal context, a discipline of science known as forensic entomology.

Data collected forensic by entomologist on arthropod populations associated with carcass can be used in a number of ways, which include determining the place where death occurred, investigate contraband goods, abuse of elderly and infants, and whether or not there was ante- mortem ingestion of toxins or drugs and to identify wound sites. However the most valuable use of forensic entomological data is the estimation of the Post-Mortem Interval (PMI).

To date, most studies dealing with successional patterns in decomposition of animal remains are conducted in temperate areas with relatively few reports from the tropical habitats [4]. Forensic entomology is at its infancy in Nigeria [5, 6]. It is in line of this that this research intend to look into the effect of mode killing on spatial successional pattern of forensically important insects in Minna Nigeria.

MATERIALS AND METHODS

Description of the Study Area

The study was carried out in Minna, the Capital City of Niger State in North-Central area of Nigeria. The area is situated within latitude 9^0 35 N and longitude $6^0$10E. Minna has a land area of 88km^2. The mean annual temperature and rainfall in the area are 39^{0}C and 1,600mm, respectively. The area enjoys typical tropical climatic conditions, with two distinct seasons namely, dry (between November and April) and rainy (May to October). The vegetation in the area is typically grass-savana dominated, often subjected to annual bush burning the soil types in Niger are two: the KU and YA soil, and the most dominant soil in terms of texture and particles sizes is sandy loamy and loamy sand soil with a pit range of 5.00-5.80 [7]

Selection of Placement Sites

Site A

Site A was the Moringa Farm of Niger State College of Education, Minna, Nigeria. This farm lies directly east of a seasonal stream, northwest of a co-pasture and is surrounded by corn, potatoes, beans, yam and groundnut farms, (during the rainy seasons). Grasses, wildflowers and common weed covers the field .The trees common to that locality are moringa and mango trees. There is moderate movement of people around. It is also the route for students that lives in Shango and people visiting the College's basketball

field. It is about 3 km from presence of vehicles with little or no commercial activities around. Reptiles, such as lizards, chameleons, snakes and wild birds as well as invertebrates such as butter flies and grasshoppers are the common animals in the site.

Site B

Site B was located in Dutsen Kura, behind the Water Board supply Unit. It is situated 20meters from major road that is always busy with movement of people and vehicles. It is a hilly place with its vegetation consisting of mostly of grasses, wildflowers and common weeds with no bigger trees. The entire neighbourhood is composed of newly built houses and a lot of construction activities still taking place with little or no commercial activities (except food vendors). High population of reptiles such as lizards, snakes and chameleon and some few wild birds constitute the vertebrates presents, while butterfly and grasshopper are the major insects present.

Sacrificing and Placement of Pig Specimens

Sacrificing the pigs

i. Four pigs (4) were killed by administration of zinc phosphide (food poisoning experiment) (8). Zinc phosphide powder 30kg was mixed with water in a small plastic bowl and ingested into the pig's mouth. This killing method was used to simulate death occurring from poisoned foods and the poison is a common rodencide used for killing rats, commonly called Commando.

ii. Four (4) other pigs were killed by stabbing (cutlass was used to stab the neck region). This killing method was used to simulate death by cutting and stabbing, as this type of killing is common among campus cultists and Nigerian political thugs. (8).

iii. Four (4) pigs, also, were killed by oxygen deprivation, a polythene bag was tight round the head to prevent the pig from breathing and was left to die . This death method will be used to simulate a natural cause of death (8).

Duration of the study

The research was carried within the period of two years (2014 and 2015). Two placements were made each year. Whereby three pigs were placed in each study site for rainy season (July to October) for the two years. Each site had each of pigs killed using the different modes. Maximum and minimum temperatures, and relative humidity were recorded on each visit using thermohydrometer.

Experimental layout

All the pigs were killed at Niger State College of Education farm. The dead pigs were immediately packed each, in a separate heavy duty polythene trash bag, labelled and transported to the placement sites, this is to prevent colonization before placement [8]. (The time lags between killing and placement for COE was approximately 5 minutes while for Dutsen Kura placement site, it was approximately 15 minutes) At the sites, the pig specimens were placed on the ground and a cage of wire mesh (20 mm mesh size) measuring

80 cm long x 50 cm wide x 60 mm high, was placed over each pig to protect it from large vertebrate scavengers [9].

Observation and Daily Data Collection

Daily records were made of temperature and humidity. On first day of deposition i.e., (after pigs were positioned) weather data were collected, as well as collection of adult insects visiting the carcasses using side-to-side sweeping of a 12 inch sweep net [10].

Insect collection

Collection were done immediately a new insect was noticed on the first day of placement, from the time of placement up to 7.00pm and were done three times daily, at 6:00am - 6:30am, 12.00pm - 12.30pm and 6.00-6.30pm from second day of placement. Before daily collections, the decomposition state of the carcasses were noted. The insects on the carcasses were collected using blunt forceps and plastic spoon for immature stages [11]. While adult flying insects were collected by aerial net sweep above and around the carcasses, pit fall traps and by taking the specimens directly off carcasses were used to collect crawling insects. In order to collect larvae at post feeding stage(pre-pupa) ,a 60cm × 30cm×15cm plastic trays containing sawdust were placed under the four corners [12].This is to trap migrating pre-pupa stage of insect species ,starting from third day post-mortem, the trays were removed daily and all immature stages recovered from these trays were transported to the laboratory for rearing until no immature stages were found on the carcass Only half ($^1/_2$) of representative of every life stage were collected to prevent dwindling effects of sampling on the outcome of the study.

Identification of insects

Insects collected (both adult and immature stages) were identified using aids and taxonomic keys proposed by [13, 14, 15]. The evaluation of the decomposition stages was classified using the terminology of payn and king

RESULTS

The effect of mode of killing on spatial variation in time of arrival of adult insects on pig carcass is shown in table (1.0).Analysis has revealed no significant ($P>0.05$) difference in time of arrivals of a species between the two study sites for any method of sacrifice. However significant ($P<0.05$) differences existed in those among different species for any site with exception of poisoning mode of sacrifice.

At Dutsen Kura the arrival time ranged from 5.00 minutes (*M. domestica*) to 5.00$\pm$0.50 days (*D. maculates and T. abtas*) for stabbing methods of killing, while For oxygen deprived method of killings, these times ranged from 5.50$\pm$0.70 minutes (*M .domestica*) to 6.00$\pm$0.00 *days (D. maculates)* . Meanwhile, at COE the arrival time ranged from 5.00$\pm$0.00 minutes (*M. domestica*) 5.50$\pm$0.50 days *(D. maculates*) for both oxygen deprivation and stabbing methods of killing. In poisoned pigs however, these times ranged respectively, for COE and Dutsen kura from 4.50$\pm$3.53 hours to 7.00$\pm$0.00 hours and 5.80$\pm$2.12 hours to 7.00$\pm$0.00 hours.

Table 1.0: Effect of mode of killing on spatial variation in time of arrival of insects on pig carcasses in Minna

Insect species	Mode of Killing					
	Stabbing		Oxygen deprivation		Poison	
	COE	DK	COE	DK	COE	DK
Musca domestica	5.00±0.00$^{a}_{a}$ mins	5.00±0.00 $^{a}_{a}$ Mins	5.00 ±0.00$^{a}_{a}$ Mins	5.50±0.70$^{a}_{a}$ Mins	4.50±3.53$^{c}_{c}$ hrs	5.80 ±2.12$^{c}_{c}$ hrs hr
Lucilla sericata	41.50±0.70$^{b}_{b}$ mins	42.00±0.00$^{b}_{b}$ mins	58.00±0.00$^{b}_{b}$ mins	59.00±11.3$^{b}_{b}$ mins	7.00±0.00$^{c}_{c}$hrs	7.00±0.00$^{c}_{c}$ hrs
Chrysomya albiceps	57.50±5.65$^{b}_{b}$ mins	58.00±0.00$^{b}_{b}$ mins	73.50±7.78$^{b}_{b}$ mins	73.00±0.00$^{b}_{b}$ mins	***	***
Chrysomya rufaficies	59.00±11.31$^{b}_{b}$ mins	50.00±0.00$^{b}_{b}$ mins	73.00±0.00$^{b}_{b}$ mins	73.00±4.24$^{b}_{b}$ mins	***	***
Hermipyrellia liqurriens	5.00±0.00$^{c}_{c}$ hrs	5.50±0.50$^{c}_{c}$ hrs	5.50±0.70$^{c}_{c}$ hrs	5.50±0.50$^{c}_{c}$ hrs	***	***
Sacophaga carnaria	1.00±0.00$^{d}_{d}$ day	1.00±0.00$^{d}_{d}$ day	2.00±0.00$^{d}_{d}$ days	2.00±0.00$^{d}_{d}$ days	***	***
Hermetia illucens	3.00±0.00$^{e}_{e}$days	3.00±0.00 $^{e}_{e}$days	3.00±0.00 $^{e}_{e}$days	3.50±0.50 $^{e}_{e}$days	***	***
Ophyra aenacens	3.00±0.00$^{e}_{e}$ days	3.00±0.00$^{e}_{e}$ days	3.00±0.00$^{e}_{e}$days	3.00±.0.00$^{e}_{e}$days	***	***
Dermestica maculates	5.50±0.00$^{f}_{f}$ days	5.50±0.50$^{f}_{f}$ days	5.50±0.50$^{f}_{f}$ days	6.00±0.00$^{f}_{f}$ days	***	***
Tachyphora abtasus	5.50±0.50 $^{f}_{f}$ days	5.50±0.50 $^{f}_{f}$ days	5.50±0.50 $^{f}_{f}$ days	5.50±0.50 $^{f}_{f}$ days	***	***

* Values followed by same superscript alphabet in a column (for a study site in a method of sacrifice) are not significantly different at P<0.05

** Values followed by same subscript alphabet in a row (between study site for a method of sacrifice) are not significantly different at P<0.05

*** Species not encountered

The effect of mode of killing on spatial variation in duration of stay of adult insects on pig in carcasses is shown in table 2.0. Analysis revealed that there was no significant (P>0.05) difference in duration of stay of the same insect between the two study sites for all the method of sacrifice. In the poisoned carcass all insects encountered stayed for less than 9 days on the carcass ranging from 4.50±3.35days (*L. sericata)* to 7.00±0.00 (*M. domestica*). Meanwhile, in stabbed and oxygen deprived carcasses, it was also observed that *L. sericata*, *C. albecep*, *A. liqurriens, C. rufafices and S. carnaria spent* between 9.00±0.00 and 10.50±1.50, but *M domestica* though a calliphorid stayed longer (range = 16.00±0.00 to 17.50 ± 0.00). However *O. aenacens, H. illucens and T. abtasus* stayed at the range of 22.00±0.00 to 29.50±1.29. While *D. maculates*, *N. rufipes* and Ant species stayed for longest days on the carcasses ranging from 5.00±0.58 to 60.00±0.00 days.

Table 2.0: Effect of mode of killing on spatial variation or duration of stay (days) of Adult insect species on pig (sus scrofa) on carcasses

Insect species	Mode of Killing					
	Stabbing		Oxygen deprivation		Poison	
	COE	DK	COE	DK	COE	DK
Sarcophagi canaria	$17.00\pm0.00^{c}{}_{c}$	$17.00\pm 0.00^{c}{}_{c}$	$16.50 \pm 12.12^{c}{}_{c}$	$17.00\pm1.41^{c}{}_{c}$	***	***
Lucilla sericata	$9.00\pm 0.00\ ^{b}{}_{b}$	$9.00\pm 0.00^{b}{}_{b}$	$9.00\pm0.00\ ^{b}{}_{b}$	$9.00\pm0.00\ ^{b}{}_{b}$	$5.50\pm3.53^{a}{}_{a}$	$7.00\pm0.00^{a}{}_{a}$
Chrysomya albiceps	$9.00\pm 1.50\ ^{b}{}_{b}$	$9.50\pm 1.50^{b}{}_{b}$	$9.00\pm 0.00\ ^{b}{}_{b}$	$9.00\pm0.00\ ^{b}{}_{b}$	***	***
Chrysomya rufaficies	$9.00\pm0.00\ ^{b}{}_{b}$	$9.00\pm 0.00^{b}{}_{b}$	$9.00\pm 0.00\ ^{b}{}_{b}$	$10.00\pm0.00\ ^{b}{}_{b}$	***	***
Hermipyrellia liqurriens	$10.00\pm10.00\ ^{b}{}_{b}$	$10.50\pm 1.50\ ^{b}{}_{b}$	$9.00\pm0.00\ ^{b}{}_{b}$	$9.00\pm0.00\ ^{b}{}_{b}$	***	***
Musca domestica	$16.50\pm12.12^{c}{}_{c}$	$16.00\pm0.00^{c}{}_{c}$	$17.50\pm1.41^{c}{}_{c}$	$17.00\pm1.41^{c}{}_{c}$	$4.50\pm3.53^{a}{}_{a}$	$7.00\pm0.00^{a}{}_{a}$
Tachyphora abtasus	$22.00\pm0.00^{d}{}_{d}$	$22.00\pm0.50^{d}{}_{d}$	$22.50\pm0.58^{d}{}_{d}$	$22.25\pm.0.50^{d}{}_{d}$	***	***
Ophyra aenacens	$28.25\pm0.16^{e}{}_{e}$	$28.00\pm0.00^{e}{}_{e}$	$29.50\pm1.29^{e}{}_{e}$	$29.25\pm0.96^{e}{}_{e}$	***	***
Hermetia illucen	$25.25\pm0.96^{e}{}_{e}$	$26.00\pm0.00^{e}{}_{e}$	$25.50\pm0.50^{e}{}_{e}$	$26.00\pm50^{e}{}_{e}$	***	***
Dermestica maculates	$50.50\pm0.00^{f}{}_{f}$	$51.00\pm0.81^{f}{}_{f}$	$50\pm0.82^{f}{}_{f}$	$50.75\pm0.96^{f}{}_{f}$	***	***
Necrobia rufifes	$55.00\pm0.00^{g}{}_{g}$	$55.00\pm0.00^{g}{}_{g}$	$57.50\pm0.70^{g}{}_{g}$	$57.00\pm0.00^{g}{}_{g}$	***	***
Ants species	$60.00\pm0.00^{h}{}_{h}$	$60.00\pm0.00^{h}{}_{h}$	$60.00\pm0.00^{h}{}_{h}$	$60.00\pm0.00^{h}{}_{h}$	***	***

* Values followed by same superscript alphabet in a column (for a study site) are not significantly different at $P<0.05$

** Values followed by same subscript alphabet in a row (between study sites for a method of sacrifice) are not significantly different at $P<0.05$

*** Species not encountered

DISCUSSION

In this present study, insect species were observed to arrive on carcasses in a successional pattern for pigs sacrificed through stabbing and oxygen deprivation while only two insects arrived on poisoned pig. The general pattern of arrival of insect species observed in this study was found to be consistent and independent of study site irrespective on mode of killing. This finding is similar with the observations of some researchers who found no differences in the arrival time and activities of insects on Rabbit carcasses for four study sites [17]. It was also observed in southern Nigeria, that insect species arrived in patterns irrespective of study site [8]. The findings of this research also tally with the report from Ghana where arrival of insect species on carcasses during the process of decomposition were found to be sequential irrespective of season and mode of killing [18]. Although seasonal variation in arrival times of various insect species were observed in some part of the world [19].

However, this study observed three distinct patterns of duration of stay of adult insects on pig carcass in the area. The first pattern of duration of stay was exploited by insect species that stayed for the first ten days of decomposition in the two study sites (COE/Dutsen Kura) and they included *L. sericata, C. albiceps, C. rufaficies, H. liqurriens and S. carnaria*. This observation is similar to those of some reseachers who observed *L. sericata* and *C. albiceps* and other Calliphorids spending less than ten days on pig carcasses in Brazil [20, 21]. However, the result of this study contradicte the report that *L. sericata*, and all *Chrysomya* species spent sixteen to eighteen days on carcasses due to climatic and ecosystem setting [22]. It is believed that understanding the duration of stay of adult insect species on carcasses during decomposition is important in accurately estimating the period of insect activity or minimum post mortem interval [23].

The second pattern of duration of adult insect activities was exploited by *M. domestica* and *H. lliqurriens* for pigs killed by stabbing and oxygen-deprivation, while on the poisoned pig, *M. domestica* exploited the first pattern of duration of stay. The third pattern of duration of stay, which is the last pattern, was exploited by the insects that stayed on the carcasses for more than twenty days to the end of the study and the insect species in this pattern included *T. abtasus, H. Illucens, O. aenacens* and ant species.

There was no seasonal variation in the duration of stay of adult insects on pigs killed through stabbing and oxygen deprivation. However, the duration of stay of adult insects on the poisoned pigs were observed to be shorter compared to the other two methods of killing. Although, it was previously observed that insects stayed for equal number of days irrespective of mode of killing [23, 24].

CONCLUSION

Though, ten number of forensically important insect species are associated with the different ecotypes of the area. Only two numbers are of universal distribution of pig carcass infestation irrespective of cause of death and the forensic insect species also exhibited distinct pattern of successional waves on pig carcass decomposition, irrespective of study site and mode of killing.

REFERENCES

1. Mann, R. W., Bass, W. M. & Meadows, L. (1990). Time since Death and Decomposition of Human Body: Variable and Observations in Case and Experimental Field Studies. *Journal of Forensic Science,* 35,103-111.

2. Hall, R. D. (2001). Introduction: Perceptions and Status of Forensic Entomology. *Medicine Veterinary and Entomology*, 9, 77-84.

3. Mawo Kelvin (2006) Insect arrival and Decomposition of Rabbit Carcass in Experimental field study *Journal of Science and Technology,* 36, 111-264.

4. Catts, E. P. & Haskell, N. H. (1990). *Entomology and Death: A Procedural Guide*. 1st edition South Carolina*,* Joyes Print Shop, pp. 182.

5. Anderson, G. S. (2001). Forensic Entomology in British Columbia: A Brief History. *Journal of the Entomological Society of British Columbia*, 98, 127-135.

6. Usua, E. J. (2007). Forensic Entomology and Humanity. *Nigerian Journal of Entomology,* 24, 1-16.

7. Agricultural Development Programme, (2011). Minna metropolis and its agricultural potentialsADP. *Paper delivered at agricultural extension programme in Minna.*

8. Ekrakene, T. & Iloba, B.N. (2011). One death many insects species yet one insects generation. *Science Alert.*

9. Stone, D., Grunner, S. & Allen, J. (2005). Assessing Error In Prediction Using A Forensic Entomological Computer Model. Available on http://ww-ncjrs.gov/pdfffiles 1/nig/grants/211/60.pdf. Retrieved 12-1-2015.

10. Campobass, C. P., Vella, G. D. & Introna, L. (2001). Factors affecting decomposition and Diptera colonization. *Forensic Science International,* 120, 18-22.

11. Anderson, G. S. & Vanlaerhoven, S. L. (1986). Initial Studies on Insect Succession on Carrion in South Western British Colombia. *Journal of Forensic Sciences,* 41(4), 617-625.

12. Rodigo, R. B., Catia, A., Alexandre, U. R. & Carvalho, Q. (2010). Temporal distribution of ten Calypteral in Rio de Janairo-Brazil*. Memorias do institute Oswal do cruz,* 105, 2-7.

13. Carvalho, L. M. & Linhares, A. X. (2010). Seasonality of insect succession on pig carcass decomposition in a natural forest area in South-eastern Brazil. *Journal of Forensic Science,* 46(3), 604-608.

14. Merit, R. W. & Benbow, M. E. (2008). A Cold Case History Involving Arthropods 28 Years after Death. *Journal of Forensic Sciences,* 52(6), 1359-1361.

15. Lee, C. (2013). Advance in taxonomic research of the calliphoridae and phoridae *Forensic Science Review*, 28, 16-39.

16. Payne J. A. & King, E. W. (1968). Lepidopteran Associated With Pig Carrion. *Journal of Lepidoptera Society,* 3, 191-195.

17. Shi, Y. X., Ashanliu, H. W. & Runjio, Z. (2009). Seasonality of Insect Succession On Exposed Rabbit Carrion*. Journal of Medical Entomology,* 4(6), 532-539.

18. Rosina, A. K., Kyorematen, B. & Boatena, A. (2013). Decomposition and Insect Succession Pattern of Exposed Domestic Pig (*Sus scrofa* L carrion)*. Journal of Agricultural and Biological Science,* 8, 11-17.

19. Martinez, E., Duque, P. & Wolf, M. (2000). Succession Pattern of Carion-Feeding Insects in Paramo, Colombia. *Forensic Science International,* 166,182-187.

20. Dupont, F., Champlain, D. L., Cyrille, A. A. & Felix, B. B. (2011). A Preliminary Study of Arthropod Associated With Carrion in Yaoundé, Cameroon. A first step in forensic Entomology in central Africa. *Journal of Ecology and Natural environment,* 3(6), 215-220.

21. Bryd, J. H. & Castner, J. H. (2001). The Development of the Black Blow Fly, *Phormia regina* (Meigen). *Forensic Science International,* 120, 79 – 88.

22. Lobna, M., Ahmed, G. & El-Amin, E. M. (2012). Decomposition and Arthropod Succession on two Monkeys (*Cercopithecus aethiopicus*). *Sudan Journal of Science,* 5(1), 11-12.

23. Rachelm, M. & Jery, K. T. (2014). Development and Validation of a New Technique for Estimating a Minimum Post Mortem Interval Using Adult blowfly (Diptera: Calliphoridae) carcass attendance. *International Journal of Legal Medicine*, 23,112 -117.

24. Abd El-bar, M. M. & Sawaby R. F. (2011). A Preliminary Investigation of Insect Colonization and Succession on Remains of Rabbit Treated with an Organophosphate Insecticide in El-Qualyu biya Governorate. *Forensic science international,* 208, 1-3