Forensic Entomology: Arthropods collected on decomposing pig carrions in Warri, Delta State, Nigeria.

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Abstract
A data base of arthropods of forensic importance was collected from pig carrions from 10th June to 10th August 2017 in the Warri city, 3 pigs were killed by cervical dislocation and left to decay while the daily assemblage of arthropods were collected from it. The result showed 5 stages of the carrion decomposition; fresh, bloated, active decay, advance decay and dry decay correspondingly despite that there was only a single sequence of decomposition. Entomofauna groups from 3 orders of Diptera, Coleoptera and Hymenoptera, with ten families were collected during the study while 233 insects were collected at the fresh stage, 324 were collected at the bloat stage, and 328 were recorded at the active decay stage, 405 at the advance decay stage and only 158 at the dry decay stage. The dominance index was high (0.09) at the dry decay stage but low (0.06) at the bloat, active decay and advanced decay stages. Shannon–Wiener index (H) was high (2.91) in the advanced decay stage but was low (2.52) at the dry decay stage. Arthropod from the orders of Diptera and Coleoptera were forensically significant as they used the carcasses for feeding and oviposition and could be used in the estimation of the post mortem interval while the order Hymenoptera used the carrion as extension of their habitat and as predatory ground to the necrophagous groups, it is advocated that more studies be carried out in different seasons using different animal models to create dependable data base of forensically importance arthropods in Warri and its environs.

Key words: arthropods, Entomofauna, decomposition, Hymenoptera, Orthoptera

Introduction

Everything that has life will one day die; death is one of the characteristics of living organisms. When an organism dies, its decaying body attracts many arthropods that use the decaying body as food, breeding sites and predating arena (Archer, 2003). During this period of decomposition, the body passes through several stages of decomposition; fresh, bloated, active decay, advance decay and dry decay (Smith, 1986) and each stage of decomposition has its own peculiar arthropod communities (Payne 1965).

These arthropods found on decaying carrions can be used to determine the cause of death, time of death (Post mortem interval (PMI)) and the place of death (Smith 1986, Anderson and Sherah, 1996, Goff *et al*., 1997). The scientific field of study that is concerned with the use of information obtained from the study of insects collected on the decaying carrions in criminal investigation is called forensic entomology (Catts and Goff, 1992, Moretti *et al*., 2008). These insects found on the decaying carrions always visit in succession until the body goes into the dry decay stage of decomposition (Early and Goff 1986, Anderson, 2001, Archer, 2003). The least PMI interval could be estimated with the arthropod communities found on the carrions at a particular stage of decomposition (Catts and Haskell 1990).

Several factors and variables affect the decomposition stages and could also cause changes in the visitation and departure time of these insects and resultantly disturb and cause errors in the PMI calculation. These factors include presence of toxins in the carrions, accessibility of the insects to the carrions, season, weather, topography and locations. Several researchers have studied the effects of these variables on the arthropods' activities on the carrions decomposition (Mann *et al*., 1990 and De Carvalho and Linhares 2001) and insects' succession (Archer and Elgar 2003). The aim of this study was to create data base of arthropod of forensic importance on decomposing pig carrions in Warri city, the result of this study will be available for usage by Law enforcement agents, Judiciary officers, Scholars and future researchers on carrion ecology in the oil rich city.

Materials and Methods

The Study Area

This study took place from 10th June to August 10th 2017 in the Biological Science Departmental garden of the College of Education Warri, Warri South Local Government Area, Delta at 05°32'34.95"N and 05°44'39.834"E. The site lies east of a botanical farm and southeast by other research crop plants. Grasses, wildflowers, herbs and weeds cover the field. The measurement of this study site approximate 300 x 200m, this size will be to reduce overlapping olfactory cues between adjacent carrions.

The Experimental Set-up for the Succession Studies

Pig was used for this study to mimic human cadaver. 3 Pigs were used in this study, each stabbed in the thorax, above the foreleg with a sharp knife to simulate a typical homicide wound, each killing was around 6.00 pm a day before the commencement of this research work and the day of their death was counted as day 0 on each trial. The pigs' carrions were deposited on the ground, guarded against vertebrate scavengers with wire mesh cages of size 160mm x100mm x 30mm as cages that permitted entrance of all the insects and other arthropods. There were an inter carcass distances of at least 40m to minimise interruption of flies from adjacent carrions (Ekrakene and Iloba 2011).

Insects Sampling Methods and Data Collection in the Succession Studies

The samples for the 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. Insects were collected manually through the use of hand nets, sweep nets for flying insects, these flying insects were collected by making fifteen swings with the sweep net in each sampling occasion, while brushes were used to comb round the animal bodies to collect those insects that were found on the bodies and hand picking were also used

manually, pitfall traps for crawling insects while the soil just under the decomposing carrions were always scanned to collect any stage of insect found hiding around as the age of the pupae was difficult to estimate.

Second instar larvae were collected from the decaying carrions in batches according to the stages of decomposition, all the daily collection of each batch were at least 30 specimens (Tracqui *et al*., 2004) and replicated thrice and reared in the transparent labelled plastic containers to adult stage in a simulated laboratory with depth of 15cm and width diameter of 11.5 cm at 25.^{0}C each (with muslin cloth covering and rubber bands that permitted ventilation and hindered the escape of the insects) containing saw-dust and part of the decaying carrion-remains to feed the immature insects, the second instars larvae were reared till adult stage (Ekrakene and Odo 2017). These collected specimens were preserved in 80% ethanol. The adult beetles that emerged from the rearing containers simply collected with forceps immediately the rearing cloth was removed and preserved in 80% ethanol respectively. These emerged adult beetles and flies were sorted to their taxonomic groups for identification (Abajue *et al*., 2017)

Insects Identification

Existing keys of identification of insects were applied in the identification of the insects that were collected in this research work: Different Orders, family, species and Genus were identified with Arneth and Jacques (1981) and Byrd and Casttner (2001).

For Diptera: Shaumar and Mohammed, (1983), Shaumar *et al*., (1998). **Coleoptera:** Shaumar *et al*., (1990); Almeida and Mise (2009). **For Hymenoptera:** Bolton *et al*., (2006).

Data analysis

Basic data analysis were done using Microsoft excel and the statistical package for social sciences (SPSS) and Graphs were used to show relationship between number of insects orders and stages of decomposition, Margalef's Richness index (d), $d = \frac{S-1}{In(N)}$, where S is the total number of species, N is the total number of individuals and In is the natural Logarithm (Log_e) while the evenness was calculated through the Shannon-Weiner Diversity index (H), $H = N\log N - \frac{\sum^{S} filog\, fi}{i=1}/N$, Evenness index I, $Evenness = \frac{H}{H\max} = \frac{H}{logS}$ while Simpson dominance index was used to evaluate the prevalence of each individual species. The index is expressed as $C = \sum(ni/N^2)$, Where; ni is the abundance of individual species N= the total number of individuals of all species while the Dominance index (D) $= \sum_{i=1}^{s} ni(ni-1)/N(N-1)$, where ni = the total of individuals in the *i*th species and N*i* = the total number of individuals.

Results

The entomofauna observed during the decomposition processes could be placed into four different groups based on their roles during the decomposing period of the carrions. They are the necrophagous, the Omnivorous, the parasites/predators, and finally the incidentals. The necrophagous insects include those insects' species that have the roles of feeding on the decaying carrion's tissues. They are the true flies, such as the dipteran families of the Calliphoridae, Sarcophagidae, Muscidae, Drosophilidae, Fannidae etc, and the Order Coleoptera (beetles) such as the families of the Staphylinidae, Dermestidae, Silphidae and Histeridae.

The second group in this study is the omnivores, which include the ants, Wasps, Bees that have the roles of feeding on both the carrions and on the larvae as well as the adult insects they found on the decaying carrions. When this group is numerous, there were reductions in the rate of decomposition by diminution of the numbers of insects that feed on the decaying carrion in all the study stations.

The third group in this study includes the parasites, parasitoids and the predators. Some of the coleopteran families and the true flies belong to this family. The families of the coleopteran Orders including the *N. rufipes*, are also members of this group. The last group of the insects that were observed during this study were the incidentals; this group includes the

cricket, grasshopper and spiders, they are just incidental to the decaying carrions.

During this study, the decomposition process was divided into five different stages; fresh, bloated, active decay, advance decay and dry decay/skeletal stages of decomposition. In the fresh stage of decomposition generally, the calliphorid flies detected the dead bodies, visited, fed and laid eggs, these eggs were laid on the natural orifices such as the mouth, nose, eyes, anus and the genital openings initially. Immediately the animals were killed, the dipterans were the first organisms to get the information of the incidents and the use of this insects species found on the decaying carrion to determine the post mortem interval seems more reliable than any other normal medical processes depending on the availability of the normal human body tissues such as blood or body fluids.

In the study, in the periods of 3 minutes, the dipterans were seen visiting the scene of the dead though initially it seems that they were not coming to lay their eggs on arrival but they started laying eggs within the first day of the study. There equally could be cellular breakdown biochemically as it was difficult to observe with unaided eyes the changes at this stage and there seemed to be no odour but something must have attracted the flies at this stage hence the carrion must have released a form of gas that did this role that served as attractant to these insect species.

At the bloated stage of decomposition, which was the second stage of decomposition, at all the study stations, and seasons, there were records of larvae during this stage. There were equally putrefaction reaction, enough odours were oozing out of the carrions and the first sign of this stage was bloating which was noticed in all the carrions at this stage of decomposition. These gases were as a result of the chemical activities of the anaerobic bacteria that brought about this stage of decomposition.

The active decay stage of decomposition: Generally, in all the study stations and seasons, there was penetration of the carrions' abdominal walls by the dipterans' larvae and adults that also brought about the deflation of the bloated carrion bringing abruptly to the end of the bloating stage of decomposition. At this stage, there was increase in the inner temperature of the carrions beyond the regular temperature of the carrions, this due to the activities of the dipterans' larvae on the bodies. There was equally steady drop in the biomass of the carrions as the larvae were getting larger, the carrions were reducing.

The advance decay stage of decomposition: this stage starts when the good numbers of the dipterans' larvae have started leaving the carrions except the larvae of the Stratiomyidae which includes the *H.illucens* leaving behind ordinary bones, cartilage, hair, little portions of the tissue and a large amount of soft moisture, jellylike materials known as By-products of Decay (BOD).

Dry decay/ skeletal stage of decomposition: At this stage of decomposition, the basic feature was the bones that were more uncovered by any materials, the BOD has dried, there were little or no cartilage based on the seasons and stations. There was gradual slow shifting from the advanced decay stages of decomposition to the dry decay stages of decomposition. The dominant insects groups found at this stage were the ants, Coleoptera of the families of Dermestidae though the Cleridae family of the species of *N.ruficolis* and *N. rufipes* were observed; they were not as many as they were in the previous stages. Some species of the true flies were very few on the carrions at this stage of decomposition both the mature and immature stages except the family of the Stratiomyidae of the species of the *H. illucens*

At the fresh stage of decomposition, first insect to arrive at the exposed pig carrions was the *C. albiceps* at 4.20 minutes after exposition, while the dominant insect species was the *C. chloropyga*. There were three Orders of insects species found on the carrions at this stage of decomposition; they were Diptera, Hymenoptera and Coleoptera while four families and twelve species respectively were also recorded. The families were Calliphoridae, Muscidae, Sarcophagidae, Staphylinidae and Fornicidae. The total numbers of insects found at this stage of decomposition were 223, which 142 of them were of the Order Diptera, 72 Hymenoptera and 9 Coleoptera. This stage lasted for only one

day before the initial sign of bloating was noticed (Table 2).

At the boated stage (Table 2), the dominant insect species was *C. sericeus* and the *L. sericata*. The stage started from day 2 and stopped at day 3 (two days) (Table 2). The total number of insects observed at this stage of decomposition was 314. While 210 of them were of the dipteran family, 67 of them were the Hymenoptera, while the remaining 37 of them were the Coleoptera (Table 2). The Order of Diptera has three families of the Calliphoridae, Sarcophagidae and Muscidae; the Order Coleoptera has one family of Staphylinidae while the Order of Hymenoptera has one family of Formicidae (Table 2).

At the active decay stage of decomposition (Table 3), the stage started on the day 4 where the bloated signs stopped and the intestines were exposed by the penetration of the insects larvae on the decaying carrions and lasted till day 8 (5days). At this stage of decomposition, there were a total numbers of 328 insects, 216 of them were Dipterans, and 44 of them were Hymenopterans while 68 of them were Coleopterans (Table 4). Among the dipterans were four families of Calliphoridae, Sarcophagidae, Muscidae and Fannidae. The Coleopterans were four families, Cleridae, Staphylinidae, Dermestidae and Histeridae while the Hymenoptera has only one family of Formicidade but the dominant insect was the *S. inzi* (Diptera:Sarcophagidae) (Table 3).

The advanced decay stage of decomposition, started on the day 9 and ended on day 12 making it a 4days period (Table 4). There were a total of 405 insects observed at this stage of decomposition, 224 of them were Dipterans, 38 were Hymenopterans, and 143 were Coleopterans (Table 4). The dominant insects' species was *M. domestica*. There were three Orders of insects at this stage of decomposition respectively; they are Coleoptera, Diptera and Hymenoptera. While the Dipteran has four families of Calliphoridae, Sarcophagidae, Fannidae and Muscidae, the Coleoptera has four families of Staphylinidae, Cleridae, Dermestidae, Histeridae and Scarabeidae (Table 4)

The dry decay stages of decomposition started from the 13th day and ended on the 60th day as the bones and the leather were in a dried stage. A total numbers of 158 insects were observed at this stage, they include 58 Diptera, 82 Hymenoptera, and 18 Coleoptera. The more dominant insects' species at this stage were *D. maculatus*, *D. ater* and the *N. ruficolis*. There were three Orders of insects at this stage, the Coleoptera, Diptera and Hymenoptera. The Coleoptera has six families of Staphylinidae, Silphidae, Scarabeidae, Cleridae, Dermestidae and Histeridae. While the Hymenoptera has only the family of Formicidae and the Diptera has two families of the Calliphoridae and Muscidae, (Table 5).

Table 1: *Entomofauna of the fresh stage of decomposition*

Order	Family	Genus/ species	Stage of life	Number
Diptera	Calliphoridae	*Chrysomya albiceps*	A, I	27
„	„	*Chrysomya chloropyga*	A, I	29
„	„	*Lucilia sericata*	A, I	20
„	„	*Calliphora vomitoria*	A,I	16
„	Muscidae	*Atherigona occidentalis*	A	13
„	„	*M. domestica*	A	15
„	Sarcophagidae	*Sarcophaga sp.*	A, I	6
„	„	*Sarcophaga inzi*	A, I	4
Coleoptera	Staphylinidae	*Staphylinus violaceous*	A	9
Hymenoptera	Formicidae	*M. senaarensis*	A	32
„	„	*Crematogaster sp.*	A	29
„	„	*Camponotus sericeus*	A	11

Key: A= Adult, I= Immature

Table 2: *Entomofauna of the bloated stage of decomposition*

Order	Family	Genus/ species	Stage of life	Number
Diptera	Calliphoridae	*C. albiceps*	A, I	18
„	„	*C. chloropyga*	A, I	21
„	„	*L. sericata*	A, I	27
„	„	*C. vomitoria*	A, I	22
„	„	*Cynomyopsis cadaverina*	A, I	12
„	Fannidae	*Fannia sp.*	A	18
„	Muscidae	*Attherogona occidentalis*	A	15
„	„	*Musca domestica*	A	17
„	Sarcophagidae	*Sarcophaga inzi*	A, I	18
„	„	*Sarcophaga sp.*	A, I	21
Hymenoptera	Formicidae	*Myremacaris senaarensis*	A	11
„	„	*Camponotus sericeus*	A	39
„	„	*Crematogaster sp*	A	17
Coleoptera	Cleridae	*N. rufipes*	A	7
„	„	*N.ruficolis*	A	12
„	Staphylinidae	*Staphylinus violaceous*	A	19

Key: A= Adult, I= Immature

Table 3: *Entomofauna of the active decay stage of decomposition*

Order	Family	Genus/ Species	Stage of life	Number
Diptera	Sarcophagidae	*Sarcophaga sp.*	A, I	12
„	„	*S. inzi*	A, I	34
„	„	*S. haemorrhoidalis*	A	6
„	Calliphoridae	*C. albiceps*	A, I	33
„	„	*C. chloropyga*	A, I	25
„	„	*L. sericata*	A, I	18
„	„	*C. cadaverina*	A, I	22
„	Fannidae	*Fannia sp.*	A, I	25
„	Muscidae	*M. domestica*	A, I	19
„	„	*A. occidentalis*	A, I	12
Coleoptera	Cleridae	*N. ruficolis*	A	16
„	„	*N. rufipes*	A	12
„	Staphylinidae	*Philonthus sp.*	A	7
„	Dermestidae	*D. maculatus*	A	9
„	„	*D. ater*	A	11
„	Histeridae	*H. monitor*	A	13
Hymenoptera	Formicidae	*Crematogaster sp.*	A	15
r„	„	*C. sericeus*	A	21
„	„	*M.senaarensis*	A	18

Key: A= Adult, I= Immature

Table 4: *Entomofauna of the advance decay stage of decomposition*

Order	Family	Genius/species	Stage of life	Number
Diptera	Muscicae	*M.domestica*	A, I	32
,,	,,	*A. occidentalis*	A, I	16
,,	Calliphoridae	*L. sericata*	A, I	29
,,	,,	*C. albiceps*	A, I	27
,,	,,	*Chrysomya sp.*	A, I	12
,,	,,	*C. cadaverina*	A,I	18
,,	Sarcophagidae	*S. inzi*	A, I	13
,,	,,	*Sarcophaga sp.*	A, I	5
,,	,,	*S. haemorrhoidalis*	A	12
,,	Fannidae	*F. canicularis*	A, I	14
Coleoptera	Staphylinidae	*S. philonthus*	A	16
,,	Cleridae	*N. ruficolis*	A	32
,,	,,	*N. rufipes*	A	28
,,	Dermestidae	*D. maculatus*	A, I	19
,,	,,	*D. ater*	A, I	22
,,	Histeridae	*Hister monitor*	A	18
,,	Scarabeidae	*Onthophagus sp.*	A	8
Hymenoptera	Formicidae	*Crematogaster sp*	A	26
,,	,,	*Camponotus sericulus*	A	12

Key: A= Adult, I= Immature

Table 5: *Entomofauna of the dry decay stage of decomposition*

Order	**Family**	**Genus/species**	**Stage of life**	**Number**
Coleoptera	Staphylinidae	*Philonthus sp.*	A	12
,,	Silphidae	*Nicrophorous tomentous*	A	4
,,	Scarabeidae	*Onthophagus sp*	A	8
,,	Cleridae	*N. ruficolis*	A	21
,,	,,	*N. rufipes*	A	18
,,	Dermestidae	*D. maculatus*	A, I	19
,,	,,	*D. ater*	A, I	17
,,	Histeridae	*Hister monitor*	A	2
Hymenoptera	Formicidae	*Odontomachis sp*	A	7
,,	,,	*C. senaarensis*	A	11
Diptera	Calliphoridae	*C. albiceps*	A	14
,,	,,	*C. megacephala*	A	7
,,	,,	*L. sericata*	A	3
,,	Muscidae	*M. domestica*	A	6
,,	,,	*H. minutea*	A	4

Key: A= Adult, I= Immature

Period of decomposition of the pig carrion

While the fresh stage of decomposition (figure 1) started immediately after the animal was killed, it lasted for just one day. The bloated stage started from the day 2 and ended on the day 3 making two days. The active stage was five days, started at the day 4 and ended at the day 8. The advanced decay stage was four days, started from day 9 and ended on day 12 and the dry decay/skeletal stage started from day 13 and lasted to day 60 when the insects were gone but the bones and remaining skin were still there and could last for several more months (Figure 1)

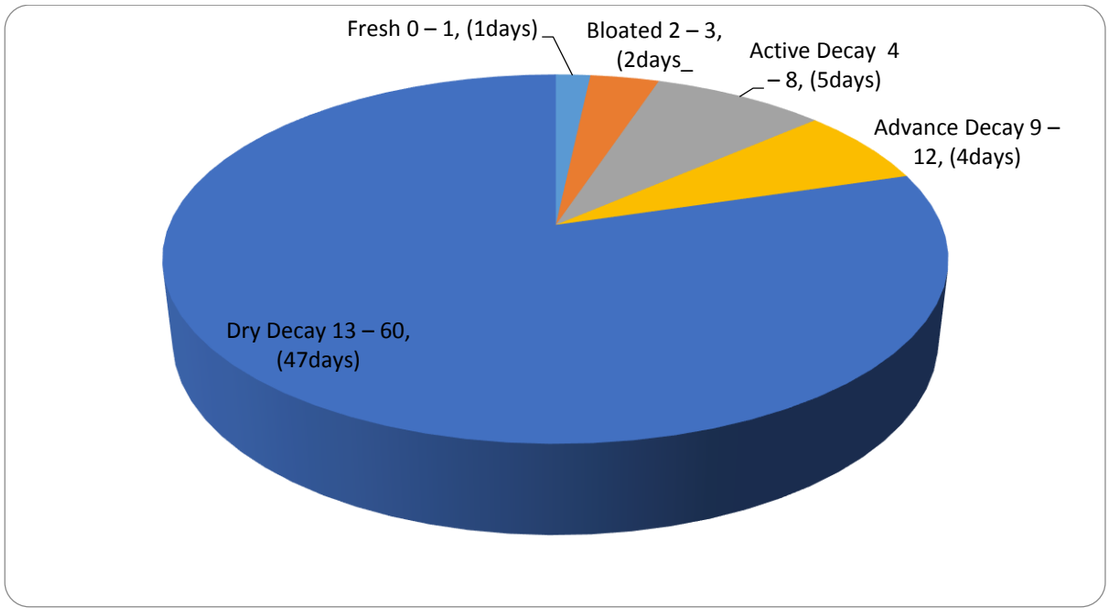

Figure 1: *The period of decomposition of the pig carrion*

Numbers of Insects encountered at stages of decomposition

At the fresh stage of decomposition at the station one during the wet season, 223 insects were observed, 142 of these insects were of the Order of Diptera, and 72 of them were the Hymenoptera while the remaining 9 were Coleoptera (Figure 2) and the bloated stage of decomposition, there were 314 insects encountered, 210 were members of the Order Diptera, 67 belong to the Order Hymenoptera while the remaining 37 belonged to the Order Coleoptera while at the active decay stage of decomposition, 328 insects were encountered, while 216 were of the Order Diptera, 44 of them were of the Order Hymenoptera and the remaining 68 were Coleopterans but at the advanced decay stage, the total numbers of insects observed were 405, 224 of them were members of the Order Diptera, 38 were Hymenopteran Order and the remaining 143 were Order Coleoptera (Figure 2). At the dry decay/skeletal stage of decomposition, while 58 of the encountered insects were Dipterans, 82 were Hymenopterans, and the remaining 18 were Coleopterans.

The total numbers of the dipterans encountered at this station during the wet season were 850, they were highest at the advanced decay stage of decomposition accounting for 224, while 216 were encountered at the active decay stage, 210 at the fresh stage and the least were at the dry decay stage of decomposition (Figure 2) while the total numbers of the Hymenoptera encountered were 226, their frequencies were highest at the decay stage (82), followed by 72 at the fresh stage, 67 at the bloated stage, 44 at the active decay stage and least at the advanced decay stage but for the hymenopterans, a total 273 were encountered, the least were at the active decay stage (9), but the highest was at the advanced decay stage of decomposition in which143 was observed, 68 were encountered at the active decay stage while 37 was encountered at the bloated stage and 18 at the dry decay stage .

Summarily, 1428 insects were encountered, 223 were at the fresh stage, 314 at the bloated stage, 328 at the active decay, 405 were at the advance decay and 158 at the dry decay/skeletal stage of decomposition.

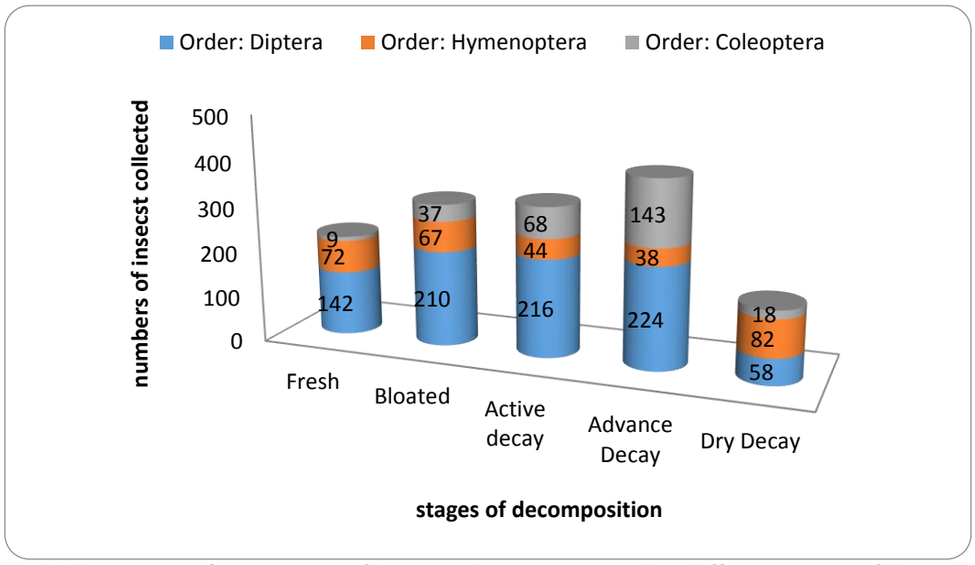

Figure 2: *Frequency of occurrence of insect orders encountered at different stages of decomposition*

Spatial species diversity for the insect species;

Diversity index for the insect species in pig carrion at different stages of succession

Simpson index was high (0.94) in the bloated, active decay and advance decay stages but low (0.91) in the fresh and dry decay stages. The dominance index was high (0.09) in the dry decay stage but low (0.06) in the bloated, active decay and advance decay stages respectively while **Shannon–Wiener index** (H) was high (2.91) in the advance stage but low (2.52) in the dry decay stage. The evenness index (E) was high (3.19) in the advanced decay stage but low (2.50) in the fresh stage (Table 6). Richness index for the insect species in pig carrion at different stages of succession and **species richness; Margalef** (R) was high (3.19) in the advanced decay stage but low (2.50) in the fresh stage (Table 6).Equitability index for the insect species in pig carrion at different stages of succession The **equitability index** was high (0.98) in the bloated stage but low (0.93) in the dry decay stage Table 6.

Table 6: *Diversity of insect species in pig carrion at different stages of decomposition*

Indices	Stages		Active	Advanced	
	Fresh	Bloated	decay	decay	Dry decay
Dominance	0.09	0.06	0.06	0.06	0.09
Simpson	0.91	0.94	0.94	0.94	0.91
Shannon H	2.60	2.88	2.86	2.91	2.52
Evenness Index	2.50	3.09	3.09	3.19	2.78
Margalef	2.50	3.09	3.09	3.19	2.78
Equitability	0.95	0.98	0.97	0.97	0.93

Discussion

The documentation of the insects of forensic importance in different geopolitical zones and regions is very important in the full application of the concept of forensic entomology in the investigation of criminal matters. This research work is an important contribution to the documentation of the insects of forensic importance in Warri City and Delta State and will serve as data base that will be accessed by future researchers and criminal investigators.

The insects connected with the decomposing pig carrions have been grouped according to the roles that they play in the process of decomposition process (Byrd and

Castner 2010, Keh, 1985: Gennard 2007). The necrophagous group are always succession in occurrence in accordance with the stages of decomposition; they feed on the decaying carrions as well as oviposite on the carcasses (Okiwelu *et al*., 2013). This group of arthropods are always highest in both number and frequencies more than the other groups and remain the dominant species on the carrion. The group are the parasitoids and predators of the necrophagous groups and their roles in the estimation of the post mortem interval and the determination of the time of death and cause of death have been less considered, they are vital on the process of decomposition. The cryptozoic group always use the carrion as shelter and refuge arena (Gennard 2007) while the incidentals always visit the decaying carrions incidentally but have no roles in the forensic entomology.

The Diptera including the families of Calliphoridae, Sarcophagidae and Muscidae were the earliest necrophages insect group, they play significant roles in the decomposition processes and on the determination of the post mortem interval while the `Family of Stratiomyidae are only secondary necrophgous (Okiwelu *et al* 2013). The Families of Dermestidae and Histeridae among others were the predators and parasites of the necrophagous groups and were witnessed much during the active and advanced decay stages of decomposition but the Family of Formicidae, Orthoptera and spiders were cryptozoic and millipede and Monomorium minimum were incidentals, they incidentally found themselves on the decaying carrions.

This study provides necessary information on the insects of forensic importance on the decomposing pig carrion at the Warri City, Delta State, Nigeria where little or no work has been done on the documentation of forensically importance insects on the pig carrions. The major Orders of insects witnessed were Diptera, Coleoptera and Hymenoptera respectively, this confirms the result of Ekrakene and Odo (2017) who equally recorded the three Orders of insects on the decomposing rabbit carrions at College of Education Warri but was in variance with the findings of Okiwelu *et al*., (2013) that apart from recording of the Diptera, Coleoptera and Hymenoptera also recorded Araneida, Orthoptera and Lepidoptera this could be as a result of seasonal and geographical factors as well as the carrion types.

Conclusion:

This investigation reveal that the pattern of decaying of carrions and insects succession must be studied in every region for the effective implementation of the forensic entomology in the real live legal system in this part of the world, several families of insects visited the carrion at predictable pattern and if properly studied, the knowledge will enhance the quick and advanced method of distension of justice. Further research works are needed to be carried out in the Warri City and other Cities in this part of the world for the actualisation of the goal of using insects and their products for forensic entomology. In-depth study on the different species of insects is also very important especially on the biological and ecological behaviours of the particular species in Warri and its environs.

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