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# A Wet Season Study of Insects' Community and putrefying manner of Rabbit (*Oryctolagus cuniculus)* Carcasses at the College of Education, Warri, Delta State, Nigeria

**P.E Odo [1,*] and B.N. Iloba [1]**

[1]*Department of Animal and Environmental Biology, Faculty of Life Sciences, University of Benin, Benin City, Edo State, Nigeria.*

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*Corresponding Author:*
*Odo Patrick Emeka,*
*odopatrickemeka@gmail.com*
*+2347035120096,*

## Abstract

An ample study of the entomofauna recovered on the putrefying Rabbit carcasses at the College of Education, Warri was undertaken with the aim of establishing a data base of insects found on the Rabbit carcasses. Six healthy Rabbit *(Oryctolagus cuniculus)* were killed by cervical dislocation and left to decay and studied for 46 days from April 2nd to May 18th 2019 with daily check and gathering of insects found on the carrions. The outcome revealed five peculiar stages of the carrion decomposition, fresh, bloat, active decay, advance decay and dry decay stages correspondingly despite that there was only a single string of decomposition. Entomofauna groups from six Orders of Diptera, Coleoptera, Hymenoptera, Orthoptera, Lepidoptera and Spider with twenty families were collected during the study. Most of the arthropod groups from the Orders of Diptera and Coleoptera were forensically significant; this is because of the fact that they used the decomposing Rabbit carcasses for either feeding and/or egg laying hence producing their young ones, because of this could be used in the estimation, prediction and calculation of the post mortem interval. On the other hand, the Hymenoptera especially the family of Formicidae may not be of any forensic importance, their activities as observed during the study could be a source of great error in the estimation of the Post mortem interval while Lepidoptera, Spider, Orthoptera and some other Hymenoptera were just secondary in purpose and used the decaying rabbit carcasses as safe quiescent arena , as a matter of fact, this research call for more researches to be carried out in the Warri and its environments in different reasons using different animal models to create a more comprehensive and more credible forensically significant database at the oil rich City.

## 1. Introduction

For more than four million years, insects have been living in the environment and it could be believed that they seem to be the highest flourishing forms of life that has ever arisen on this planet. Approximately a half of the globe's more than one million species of the animals are insects [1]. Several varieties of insects exist apart from those that we have named and the historical permutations have indicated as great as one hundred million while many believed this time around that we compete on this earth with between five and fifteen millions of these animal species that these bugs could be of considerable percentage [1].

Human being has for long subjugated the bionetwork and tailored the ordinary process of the globe on his own capacity. Life is endowed with its way and out of its finest significances stands as the food chain that is the scheme of consuming and being consumed. He noted that the scheme is so enormous

that even the animal carrions including man are decayed by other organisms, with the insects playing a principal responsibility [2]. Before these days, in the urbanized countries, crawling or non living larvae found on the original openings and wounds or cadavers were assumed nauseating part of the rot as earlier as bodies were positioned on the table for post mortal analysis. Those maggots were mainly washed despite any kind of applicable fact collected from them. According to [3], while the firearms examination ballistic, bite-marks, gun powder dregs chemistry, spray of blood scrutiny and among several criminological rudiments have been examined and cultured, the arthropods allied with the death scene were immensely uncared for resulting in much of urge to novel concepts in the area of forensic entomology that is the discipline of the usage of insects substantial proof to unearth state of affairs of interest to law, regularly linked to misdemeanor

Forensic entomology deals with the use of the knowledge of insects in the criminal and civil investigation. It is an old science as it has been initially documented in China in the 13$^{th}$ century and until 1960s' that the discipline started to be acknowledged. Carrion flies detach putrefying organisms' rich nutritive materials always; although some species are found in every environmental type, several others are scarcely native. Diverse groups of insects are found in dissimilar dwelling areas with some of them living in urban or rural areas but some live in both areas [4, 5]. An amount of variables can influence post-mortem interval (PMI) estimates such as physical, chemical, climate, scavengers, toxins and physical barriers [6, 7] finally, there is always insects colonization and decomposition.

The concept of burying a body of a victim of assassination is a trendy physical barrier chosen by murderers who decide to dispose a body, a number of works have observed that these buried bodies decompose at a sluggish pace than those bare to the air [8, 9]. These assailants scarcely burrow the graves deeper than 30 cm and 60 cm, the rationale for this is because they don't want to be trapped around their victims' putrefying carrions. The suitable assessment of the entomofauna recovered on a decaying a body with the full familiarity of the prospect environmental variables such as temperature and relative humidity can often be a consistent forensic revelation [7] These methods encompass the guess of the time after death occurred, disturbance or transferring the carrion after demise to more hidden place, suggestion of wounds and the existence of toxins among others. The decaying body attracts many insects and other arthropods in a prototype of relative consecutive way.

Several professionals on carrion ecology have studied the decomposition processes including the successive wave of insects communities on the decomposing bodies using different animal model, Several other animal models have been used in the forensic entomological studies as human models by several authors, they include, rabbits, pigs, cats, dogs, mice, birds, turtle, and elephants while parts of the animals bodies such as pork, beef, liver of goats, liver of cow, blood of goats, blood of cows, ice fish, fresh fish among others [10-19].

## 2. Materials and Methods

### 2.1 *The Study Area*

This study took place in the Biological Science Departmental garden of the College of Education Warri, Warri South Local Government Area, Delta State

### 2.2 *The Location of the Study Area*

Warri 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 starts from November and ends in April with a cold harmattan between December and January. Warri ranges from 32º to 37º at altitude of 21m with mean annual rainfall of 2673.8mm. The natural vegetation is rain forest; the forest is rich in timber trees and other flowering plants [20]. The site is located 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.

2.3 *Experimental Animals*

Different nonhuman animal models have been used globally in the carrion ecological studies, these includes, sheep [21] rabbits [19], Guinea pigs [22],Pigs [22], foxes [23], birds [24], Lizard and toads [25], Elephants [18], Turtle [17], Seals [26]. Rabbits (*Oryctolagus cuniculus*) were used for this study to mimic human cadaver.

2.4 *The Experimental Set-up for the Succession Studies*

Six rabbits were used in this research work (three replicate), each of them was stabbed in the thorax, under the foreleg with a sharp knife to imitate a archetypal murder abrasion, each killing was around 6.00 pm a day before the commencing of this research work and the day of their death was counted as day 0 on each trial. The carrions were placed into profound trash bags and carried from the killing place to the respective studying sites. The carrions were deposited on the ground, guarded against vertebrate scavengers with wire mesh that permits entrance of all the insects and other arthropods and cosseted the carrions against the other bigger animals. The wire meshes of 160mm x100mm x 30mm were used to form cages of height and width 30 cm and 20 cm respectively, the iron cages were removed on each sampling occasions. There were an inter carcass distances of at least 40m to minimize interruption of flies from adjacent carrions.

2.5 *Insects' Sampling Methods and Data Collection in the Succession Studies*

The samples for the entomofauna were collected two times per day at 10 and 14.00 GMT for the initial week while once daily for the remaining weeks. Insects were collected physically 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 pupating or hiding around. Second instars larvae were collected from the decaying carrions and the maggots from each carrion were reared in the translucent synthetic containers 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 young insects, the second instars larvae were reared till adult phase.

2.6 *Insects Rearing for the Succession Studies*

The arthropods maggots found on the decomposing rabbit carrions were collected in phases with the student art brush and blunt forceps, the first batch of the larvae were collected on the days that carrions were in the bloated. The second phases of the larvae were collected on the days that the carrions were in the active decay stage of decomposition. The third phases of the larvae were collected on days that the carrions were in the advance decay stages of decomposition, the fourth phases were collected when the carrions were in the dry decay stage of decomposition. All the daily collection of each phase were at least 30 specimens were replicated thrice and reared in the translucent labeled synthetic containers to adult phase in a simulated laboratory in their respective study areas. Part of the decaying carrions were cut and used in the feeding of the larvae in the rearing containers, muslin cloth served lids of the rearing containers, held with rubber tube. When the adults emerged, each of the containers was cautiously

emptied into a larger container semi-filled with soap solution. The rubber tube of the smaller containers was quietly disconnected while the muslin cloth was intact. The larger container was covered with another muslin cloth and held with rubber tube. Then the muslin cloth of the rearing container was watchfully disconnected with forceps. The insects were permitted to escape into the larger container and were drowned in the soap solution and were gathered together with forceps and preserved in 80% ethanol and were later sorted to their taxonomic groups for categorization, identification and classification.

2.7 *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 [27,28]
**For Diptera:** [29, 30, 31, 32, 33, and 34]
**Lepidoptera**: [35]
**Coleoptera:** [36, 33, 37, 38]
**For Hymenoptera:** [39, 40, and 41].

2.8 *Data Analysis*

Basic data analysis were done using Microsoft excel and the statistical package for social sciences (SPSS), graphs were used to demonstrate the relation between one variable and the other.

## 3. Result and Discussion

3.1 *Entomofauna encountered at the decomposing rabbit carrion*

There were five stages of decomposition observed during the rabbit's decomposition process; fresh, bloat, active decay, advance decay and dry decay stages of decomposition respectively despite the fact that the decomposition is just a single process. During the fresh stage of decomposition, only the Orders of Diptera and Hymenoptera were recorded, the Diptera was the first visitors on the decaying carrions while ants of the family Formicidae, Order, Hymenoptera were also collected at this initial stage of decomposition (Table 1) but at the bloat stage of decomposition, there were three orders, Diptera, Coleoptera and Hymenoptera (Table 2) and during the active decay stage of decomposition, there were also three orders, Diptera, Coleoptera and hymenoptera (Table 3) but at the advanced decay stage of decomposition, there were five Orders insects and a non insect recorded, Diptera, Coleoptera, Hymenoptera and Orthoptera, Lepidoptera, orthoptera and spider (Table 4) and during the dry decay stage of decomposition there were Spider, Orthoptera, Coleoptera, Diptera, and Hymenoptera making it four insects and one none insect orders recorded (Table 5).

**Tabe1** Fresh stage of decomposition

| Order | Family | Genus/Species | Life stages | Numbers |
|---|---|---|---|---|
| **Diptera** | Calliphoridae | *Lucilia sericata* | A | 06 |
| „ | „ | *Chrysomya albiceps* | A | 08 |
| „ | „ | *Chrysomya vomitoria* | A | 02 |
| „ | Muscidae | *Musca domestica* | A | 07 |
| „ | „ | *Sarcophaga inzi* | A | 04 |
| **Hymenoptera** | Formicidae | *Atta texane* | A | 07 |

**A=Adults, I= Immature**

*Fresh stage of decomposition*

The fresh stage of decomposition began immediately the rabbits were kill and stopped immediately the initial sign of bloating was noticed on the decaying rabbit carrions. This stage of decomposition took only 1 day. There were only 7 species of arthropods recorded on the decaying rabbit carrions, the species

were *Lucilia sricata* (Diptera: Calliphoridae), *Chrysomyia albiceps* (Diptera: Calliphoridae), *Chrysomyia vomitoria* (Diptera: Calliphoridae), *Musca domestica* (Diptera: Muscidae), *Sarcophaga inzi* (Diptera: Sarcophagidae) and *Atta texane* (Hymenoptera: Formicidae) (Table 1).

**Table 2** Bloated stage of decomposition

| Order | Family | Genus/Species | Life stage | Numbers |
|---|---|---|---|---|
| **Diptera** | Calliphoridae | *L. sericata* | A, I | 12 |
| „ | ,, | *C. albiceps* | A, I | 17 |
| „ | ,, | *C. vomitoria* | A | 04 |
| „ | ,, | *Phormia regina* | A | 02 |
| „ | Muscidae | *M. domestica* | A | 09 |
| „ | Drosophilidae | *Drosophilia sp* | A | 09 |
| „ | sarcophagidae | *S. inzi* | A, I | 06 |
| „ | ,, | *Sarcophaga haemorrhoidalis* | A, I | 07 |
| „ | Asilidae | *Efferia aestuan* | A | 02 |
| „ | Stratiomyidae | *Hermetia illucens* | A,I | 04 |
| **Coleoptera** | Cleridae | *Necrobia rufipes* | A | 02 |
| „ | ,, | *Necrobia ruficolis* | A | 06 |
| **Hymenoptera** | Formicidae | *A. texane* | A | 04 |
| „ | Formicidae | *Myremecaris sp* | A | 02 |

**A= Adults, I= Immature**

*Bloat stage of decomposition*

There were 14 species of arthropods collected during this stage of the rabbit decomposition. All the insects species recorded at the fresh stage of decomposition were also recorded during this stage while other insects recorded at this stage include *Phormia regina* (Diptera: Calliphoridae), *Drosophilia sp* (Diptera: Drosophilidae), *Sarcophaga haemorrhoidalis* (Diptera: Sarcophagidae), *Efferia aestuans* (Diptera: Asilide), *Hermetia illucens* (Diptera: Stratiomyiidae), *Necrobia rufipes* (Coleoptera: Cleridae), *Necrobia ruficolis* (Coleoptera :Cleridae), *Myremecaris sp* (Hymenoptera: Formicidae) (Table 2).

**Table 3** Active decay stage

| Order | Family | Genus/species | Life stage | Numbers |
|---|---|---|---|---|
| **Diptera** | Stratiomyidae | *H. illucens* | A | 05 |
| „ | Asilidae | *E. aestuans* | A | 04 |
| „ | Muscidae | *M. domestica* | A, I | 14 |
| „ | ,, | *Isomyia evanida* | A, I | 06 |
| „ | Calliphoridae | *L. sericata* | A, I | 12 |
| „ | ,, | *C. albiceps* | A, I | 10 |
| „ | ,, | *C. vomitoria* | A, I | 08 |
| „ | ,, | *P. regina* | A | 05 |
| „ | Drosophilidae | *Drosophilia sp* | A | 04 |
| „ | Sarcophagidae | *S. inzi* | A, I | 07 |
| „ | ,, | *S. haemorrhoidalis* | A, I | 05 |
| „ | ,, | *Sarcophaga sp* | A | 04 |
| **Coleoptera** | Cleridae | *N. ruficolis* | A | 07 |
| „ | ,, | *N. rufipes* | A | 09 |
| „ | Dermestidae | *Dermestid maculatus* | A | 04 |
| „ | Silphilidae | *Nicrophorous investigator* | A | 08 |
| „ | ,, | *Dermestid ater* | A | 02 |
| „ | Meliodae | *Mylabris trifasciata* | A | 04 |
| | ,, | *Pyrota palpalis* | A | 02 |
| „ | Histeridae | *Hister monitor* | A | 05 |
| „ | Staphylinidae | *Philonthus cogranthus* | A | 07 |
| **Hymenoptera** | Formicidae | *Monomonium minimum* | A | 20 |
| „ | ,, | *Camponotus pennsylvanicus* | A | 15 |

**A= Adults, I= Immature**

*Active decay stage of decomposition*

At the active decay stage of decomposition of the rabbit carrions, there were 23 species of insects collected from the decaying rabbit carrions. These species include all the species recorded in the fresh

and bloat stages of decomposition while the novel species Coleoptera were becoming dominant at this stage with very few Hymenoptera, they were *Dermestid maculatus* (Coleoptera: Dermestidae), *Mylabris trifasciata* (Coleoptera: Meoidae), *Hister Monitor* (Coleoptera: Histeridae), *Philonthus cognathus* (Coleoptera: Staphylinidae) *Monomorium minimum* (Hymenoptera: Formicidae) and *Camponotus pennsylvanicus* (Hymenoptera: Formicidae) (Table 3).

*Advanced decay stage of decomposition*

During the advanced decay stage of decomposition the rabbit carrions, the number of the Diptera have been drastically reduced while Coleoptera were becoming dominant, many arthropods species were recorded, these species includes some of the species recorded in the previous stages while the new species of insects recorded were *Nicrophorous investigator* (Coleoptera: Silphidae), *Pyrata palpalis* (Coleoptera: Histeridae), *Philonthus cognatus* (Coleoptera: Staphylinidae), *Diabrotia undecipuntata* (Coleoptera: Chrysomelidae), *M. minimum*, *C. pennsylvanicus*, an unidentified spider, *Hewitsonia boisoduvalii* (Lepidoptera), *Euphaedra losingawardi* (Lepidoptera), *Stemfferia standingeri* (Lepidoptera), and *Obania subvariegata* (Lepidoptera) (Table 4).

**Table 4** Advance decay stage of decomposition

| Order | Family | Genus/Species | Life stage | Numbers |
|---|---|---|---|---|
| Diptera | Stratiomyidae | *H. illucens* | A, I | 20 |
| ,, | Asilidae | *E. aestuan* | A | 02 |
| ,, | Drosophilidae | *Drosophilia sp* | A | 06 |
| ,, | Muscidae | *M. domestica* | A, I | 09 |
| ,, | Calliphoridae | *L. sericata* | A, I | 06 |
| ,, | ,, | *C. megacephala* | A, I | 07 |
| ,, | ,, | *C. albiceps* | A, I | 20 |
| ,, | ,, | *P. regina* | A, I | 06 |
| ,, | Sarcophagidae | *S. inzi* | A | 05 |
| Coleoptera | Cleridae | *N. ruficolis* | A | 15 |
| ,, | ,, | *N. rufipes* | A | 12 |
| ,, | Dermestidae | *D. ater* | A | 09 |
| ,, | ,, | *D. maculatus* | A | 12 |
| ,, | Meloidae | *Mylabris trifaciata* | A | 06 |
| ,, | Silphidae | *Nicrophorous investigator* | A | 04 |
| ,, | Histeridae | *Hister monitor* | A | 05 |
| ,, | -- | *Pyrota palpalis* | A | 04 |
| ,, | Staphylinidae | *Philonthus cognatus* | A | 15 |
| ,, | Chrysomelidae | *Diabrotia undecipuntata* | A | 06 |
| Hymenoptera | Formicidae | *Monomorium. Minimum* | A | 20 |
| ,, | ,, | *Camponotus Pennsyvanicus* | A | 08 |
| ,, | ,,, | *Sceliphron caementarium* | A | 07 |
| Orthoptera | Acrididae | *Melanoplus differentialis* | A | 02 |
| Spider | - | *Unidentified* | A | 03 |
| Lepidoptera | | *Hewitsonia boisoduvalii* | A | 04 |
| ,, | | *Euphaedra losinga wardi* | A | 02 |
| ,, | | *Stempfferia standingeri* | A | 03 |
| ,, | | *Obania subvariegata subvariegata* | A | 06 |

**A=Adults, I= Immature**

*Dry decay stage of decomposition*

During the dry stage of decomposition of the rabbit carrions, there were only 16 species of insects collected, these species include Diptera members, Coleoptera and Hymenoptera , *Formica pallid- fulva* (Hymenoptera: Formicidae), *Forelium pruinosus* (Hymenoptera: Formicidae), and *Wasmania aripunctata* (Hymenoptera: Formicidae) were the new species collected at this stage of decomposition (Table 5).

**Table 5** Dry decay stage of decomposition

| Order | Family | Genus/species | Life stage | Numbers |
|---|---|---|---|---|
| **Diptera** | Muscidae | *M. domestica* | A | 04 |
| „ | Calliphoridae | *C. albiceps* | A | 06 |
| „ | „ | *L. sericata* | A | 04 |
| „ | Sarcophagidae | *S. inzi* | A | 03 |
| „ | Stratiomyidae | *H. illucens* | A | 16 |
| **Coleoptera** | Histeridae | *H. monitor* | A | 12 |
| „ | Dermestidae | *D. atar* | A | 14 |
| „ | „ | *D. maculatus* | A | 16 |
| **Orthoptera** | Acrinidae | *Melanoplus. differentialis* | A | 02 |
| **Spider** | | *Unidentified* | A | 07 |
| **Coleoptera** | Cleridae | *N. ruficolis* | A | 09 |
| „ | „ | *N. rufipes* | A | 08 |
| **Hymenoptera** | Formicidae | *M. minimum* | A | 28 |
| „ | „ | *Formica-pallide-fulva* | A | 07 |
| „ | „ | *Forelium pruinosus* | A | 08 |
| „ | „ | *Wasmania arupunctata* | A | 06 |

A=Adults, I= Immature

3.2 *Number of insects encountered at each stage of decomposition during the sampling*

There were a total of 661 insects recorded on the decaying rabbit carrion in this study, 36 of them were recorded during the fresh stage, and 86 during the bloated stage, 167 were recorded during the active decay stage, while the highest number were recorded at the advanced decay stage where 222 were collected and only 150 were recorded during the dry decay stage of decomposition respectively (Table 1 and Figure 1). However, there were 299 dipterans collected all through the stages of decomposition, 29 0f them were recorded during the fresh stage of decomposition while 72 were recorded during the bloated stage of decomposition but at the active decay stage of decomposition there were 84, showing the peak of the dipteral's activities on the rabbit carrion and at the advanced decay stage of decomposition, 81 of the diptera were recorded and only 33 of them were recorded at the dry decay stage of decomposition indicating the least number of dipterans encountered during the decaying stage of the rabbit carrion respectively (Table 1 and Figure 1).

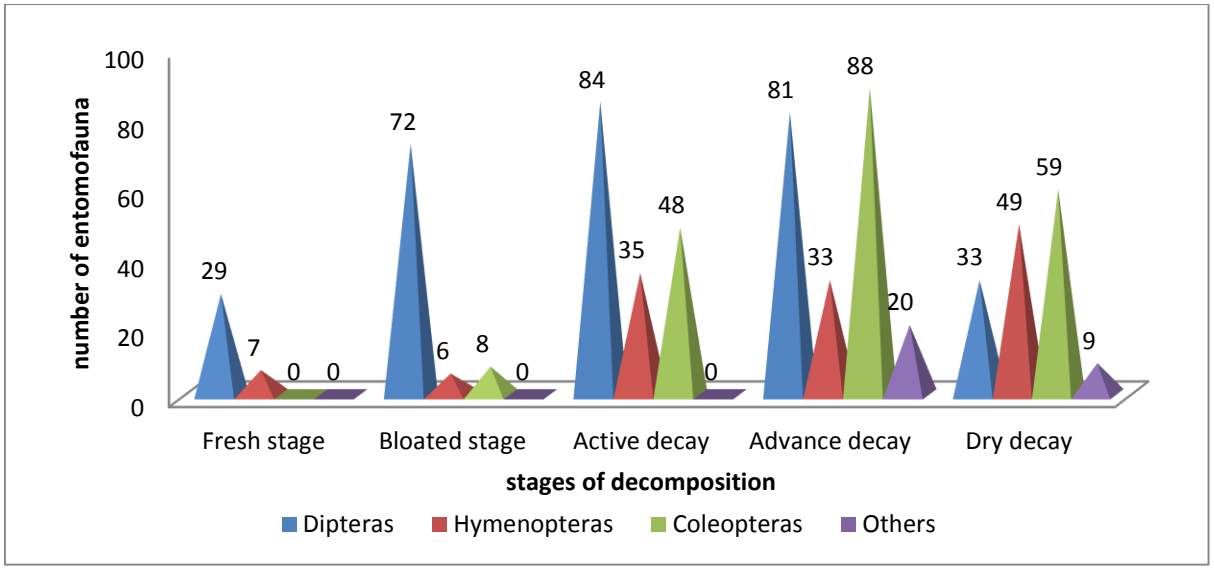


**Figure 1** Number of insects encountered at each stages of rabbit's decomposition during the sampling

There were 130 Hymenopterans recorded on the rabbit carrions in the decaying period, they were highest at the dry decay stage of decomposition where they were 49 while they were least recorded during the bloated stage of decomposition where they were only 6 in number. During the fresh stage of decomposition on the rabbit carrions, only 7 of them were collected but 35 were equally recorded during

the active decay stage of decomposition as 33 of them were also collected at the advanced decay stage of the rabbit's decaying regime. There were 203 Coleopterans collected during the rabbit's decaying process, none was collected during the fresh stage, only 8 were recorded during the bloat stage of decomposition, 48 of them were recorded during the active decay stage of decomposition while their highest frequencies were during the advance decay stage of decomposition where 88 of them were collected and 59 were also recorded during the dry decay stage of decomposition respectively (Figure 1). The non necrophagous species were not recorded during the fresh, bloat and active decay stages of decomposition but only 20 of them were recorded during the advanced decay stage and 9 during the dry decay stage of decomposition of the rabbit carrions respectively. There were a total of 299 Diptera, 130 Hymeoptera, 203 Coleoptera, and only 29 other Orders (Figure 1).

### **3.3** *The period of decomposition of the rabbit*

The total period of decomposition of the rabbit carrions were 45 days, the fresh stage of decomposition started on the day that the rabbits were killed and ended on the day 1, lasted for just 1 day while the bloat stage of decomposition started on the day 2 and ended on the day 3, took only 2 days. The active decay stage of decomposition started on the day 3 and ended on the day 4, lasted for just 2 days respectively (Figure 2). The advanced decay stage of decomposition started on the day 4 and ended on the day 8, lasting for just 5 days while the dry decay stage of decomposition of the rabbit carrions took 36 days out of the 45 days, it started on the day 9 and ended on the day 45 respectively (Figure 2).

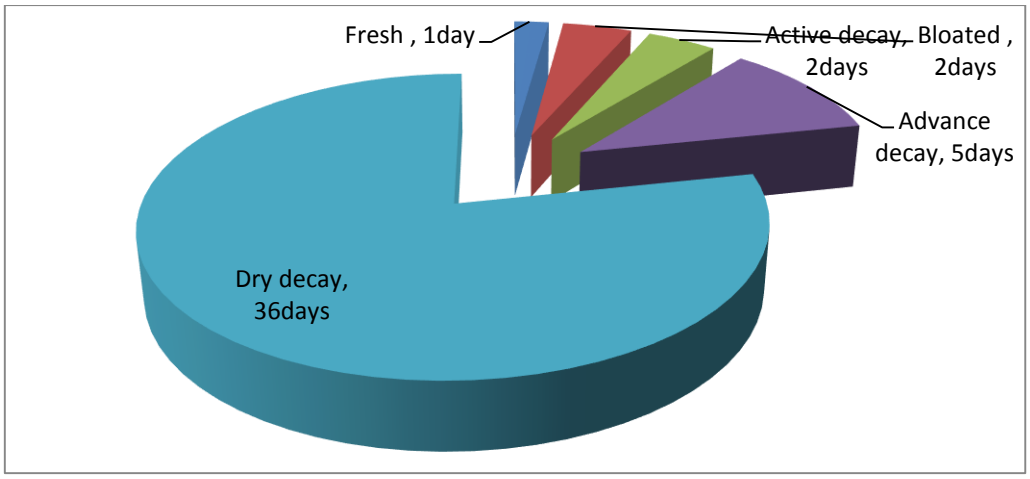


**Figure 2** The period of decomposition of the rabbit

## 4. Discussion

The insect order with the highest frequency on the decaying rabbit carrion was the Diptera that was 299 followed by the Coleopteran that was 203 on the carrions while the non necrophgous insect's orders were only 29 in number. Out of the 661 insects recorded on the rabbit carrions, there were only 36 of them recorded on the fresh stage of decomposition, 86 were also recorded during the bloat stage of decomposition and 167 were recorded during the active decay stage as the advanced decay stage of decomposition recorded the highest number of insects, 222 of them were recorded and at the last stage of decomposition, the dry decay stage of decomposition, only 150 of them were recorded.

This finding was in line with that of [19, 42] at the same Warri but in different seasons. Equally there were little disparities on the insects composition on the similar research work carried at the same College using Guinea pig and pigs (unpublished papers of [43, 15] that the other researchers at the College did not report the presence of *Efferia aestuans*, the Lepidoptera, *H. boisoduvalli* and *E. lonsingawardi*, Coleopterans members including, *D. undecipuntata*, *P. congnatus* and *M. trifasciata*, this could be as a result of different in seasons and animal model used.

There five stages of decomposition recorded during this decomposition period despite the fact that it was just a single period, the fresh, bloat, active, advanced and dry decay stages of decomposition. This was in consistence with findings of [44], but was contrary to the findings of [7] that reported only 4 stages of decomposition. When the baseline forensic insects are known in an area, it makes comparison with the insects collected on decomposing human carrions simpler for the determination of the cause and time of death. Several species of insects encountered during carrion decomposition have been identified and documented hence will be available for further perusal, usage and more in-depth studies by law enforcement agents, law officers, judiciary officers, academic scholars among others in Warri City and its environment. It is highly recommended that security agents, Federal and State Government and our higher institution of learning should endeavor to give scholarship and sponsorship to the interested young scholars and equally encourage more young ones to develop interest in this poorly paid field where obtaining job with the experience is very hard and the appropriate application of this results and findings in the real cases in our judiciary system is still a mere dream in Nigeria unlike what is obtainable in the advanced world where this concept has been in use for some decades now.

## Conclusion

Insects of forensic importance's documentation in our cities, towns and communities are very crucial in the use of insects and their products in criminal and civil matters in our judiciary system. The creation of dependable database on these insects using different animal models and in different season is very necessary in order to utilize this concept by our laws enforcement agents, though human decaying bodies are not used ordinarily for this type of research work, it is very usual to use other animals to mimic human decomposition. Among the insects orders recorded on the decaying rabbit carrions, the Diptera and Coleoptera were the orders of insects with the highest frequencies. The Diptera were the first set of insects that visited the rabbit carrions followed by the Coleoptera and are of forensic importance while Hymenoptera (Ants) caused tears and wears on the rabbit carrions and could be source of error in the determination of the post-mortem interval hence are of less forensic importance

## References


1. C. McGavin, *Expedition Field Technique*: Insects and other arthropods, The Center for Supporting field research, Exploration and Outdoor learning. Royal Geography Society with IBG, 1 KensigtonGore, London SW 72AR (2007) ISBN 09076497422
2. D. Aggarwal, Estimating the Postmortem Interval with the help of entomological evidence. *Anil Aggarwal's Internet J. Forensic Medical Toxicology* 6: (2005) 2
3. E. P. Catts, Analyzing Entomological Data. *In*: P.E. Catts and N.H. Haskell (Eds.). *Entomology and Death: A Procedural Guide*. Joyce's Print Shop, Clemson, SC (1990) 124-137
4. N. H. Haskell, R. D. Hall, V. J. Cervenka, M. A. Clark, on the body: insects' stage presence and their postmortem artifacts *In*: W.D.Haglund and M. H. Sorg (Eds.). *Forensic Taphonomy: The Postmortem Fate ofHuman Remains*. CRC Press, Boca Raton, FL (1997) 415-448
5. M.B. Horenstein, A X. Linhares, B. Rosso, M.D. Garcia, Species composition and seasonal succession of saprophagous calliphorids in a rural area of Cordoba, Argentina. *Biol Res* 40 (2007) 163-171
6. P. E. Odo, *Effects of Tramadol Hydrochloride (an opoid) on the developmental rate of Lucilia sericata* (Meig.) *(Diptera: Calliphoridae) reared on the Rabbit (Oryctolagus cuniculus) carrion.* An M. Sc. thesis submitted to the Dept. of Animal and Environmental Biology, Faculty of Life Sciences, University of Benin, Benin City, Nigeria (2016).

7. T. Ekrakene, B. N. Iloba, One death, Many Insects' generation. *Journal of Entomology* 8 (1) 2011) 27-39 https://scialert.net/abstract/?doi=je.2011.27.39
8. J. A. Payne, A summer carrion study of the baby pig (*Sus scrofa)* Linnaeus, *Ecology*, 46 (1965) 592–602. https://doi.org/10.2307/1934999
9. E. M. Pastula, *Insects timing and Succession on buried carrions in East Lansing Michigan,* an M. Sc thesis submitted to the Michigan state University (2013*).*
10. M. C. Abajue, S. C. Ewuim, C. E. Akunne, Forensic Entomology: Decomposing pig carrions and associating insect fauna in Okija, Anambra State, Nigeria. *America Journal of Biology and life science* 4(2) (2016) 6 - 11
11. R. F. Denno, W. R. Cothran, Competitive interactions and Ecological strategies of Sacophagid and Calliphoid Flies inhabiting rabbit carrions. *Annual Entomological Society of America* 69 (1976) 109-113
12. M. Nyasham, R. Masendu, G. Mawera, An initial study of insects' succession on decomposing rabbit carrions in Harare, Zimbabwe. *Asia Pacific Journal of Tropical Biomedicine*, 4 (7) (2014) 561 – 565.
13. T. Ekrakene and B. N. Iloba, Effects of Killing on Decomposition of Pig (*S. scrofa*) Carrions in benin City, Nigeria. *Nigeria Journal of Entomology*. 36 (2017) 1 – 6.
14. M. C. Abajue, S. C. Ewuim, C. E. Akunne, Preliminary checklist of flies associated with pig carrions decomposing in Okija, Anambra State, Nigeria. *Annual Research international* 11 (1) (2014) 1899 – 1904
15. T. Ajemitolu, *Insects succession on Decomposing Guinea pig carrion at the College of Education, Warri, Delta State, Nigeria.* B. Sc (Ed). Project submitted to the Delta State University, Abraka (2019).
16. M. S, Ekanem, M. C. Dike, Arthropod succession on pig carcasses in South Eastern Nigeria. *Pap Avulsos Zool (Sao Paulo);* 50(35) (2010) 561-570. https://doi.org/10.1590/S0031-10492010003500001
17. D. H. Abell, S. S. Wasti, G. C. Hartmann, Saprophagous arthropod fauna associated with turtle carrion. *Applications of Entomological Zoology* 17 (1982) 301- 307.
18. M. Coe, The decomposition of Elephants' carcasses in the Tsavo (East) National Park, Kenya. Journal of Arid Environment 1 (1978) 71-86
19. P. E. Odo, O. H. Chidi, B. N. Iloba, Insects Fauna Associated with decomposing Rabbit Carrion in Falcorp Mangrove Park, Ijala, Warri, Delta State, Nigeria. *Book of Proceeding of the Faculty of Science international Conference of the delta state University, Abraka* (2017)
*20.* A. B. M. Egborge *Water pollution in Nigeria, Biodiversity and Chemistry of Warri River, Warri*. Ben Miller Books Nig. Ltd. (1994) ISBN 0-999-768 275-288
21. B. Morris, Carcass decomposition and early arthropod's succession. *Proceedings of the 18th International Congress of Entomology*, July 3-9, 1988, Vancouver, B. C., Canada (1988) 267.
23. M. S, Ekanem, M. C. Dike, Arthropod succession on pig carcasses in South Eastern Nigeria. *Pap Avulsos Zool (Sao Paulo);* 50(35) (2010) 561-570. https://doi.org/10.1590/S0031-10492010003500001
24. W. S. Wasti, A study of the carrion of the common fowl, *Gallus domseticus*, in relation to arthropod succession, *J. GA Entomol. Soc.*, 7 (1975) 221–229
25. W. Cornaby, Carrion reduction by animals in contrasting tropical habitats. *Biotropica*, 6(1974)51-63

26. W. D. Lord, J. F. Burger, Arthropods associated with Harbor seal (*Phocavitulina*) carcasses stranded on islands along the New England coast, *Int. J.Entomol.*, 26 (1984) 282–285
27. R. H. Arnett Jr., R. L. Jacques Jr., *Simon and Shcuster's Guide to Insects*. Simon and Schuster publishers, Newyork (1981).
28. J. H. Byrd, J. L. Castner, *Forensic Entomology, The Utility of Arthropods in Legal Investigations.* CRC Press, Boca Raton, Fl (2001).
29. N. Shaumar, S. Mohammad, Keys for identification of species of Family (Sarcophagidae:Diptera) in Egypt. *J. Bull Soc Entomol .Egypt* (1983).
30. N. F. Shaumar, S. K. Mohammad, S. A. Mohammad Keys for identification of species of family Calliphoridae (Ditpera) in Egypt. *J. Egypt Soc Parasitol*,19(2) (1998) 669-681
31. H. Oldroyd, The Natural History of Flies. London: *Weidenfeld and Entomology* 37 (1964) 253 -272
32. F. Zumpt, Myiasis in Man and Animals in the Old World, Butterworths, London. Rodriguez, W. C. and W. M. Bass. 1983. Insect activity and its relationship to decay rates of human cadavers in east Tennessee, *J. Foren. Sci.*, 28: (1965) 423–43
33. R. F. Denno, W. R. Cothran, Niche Relationships of a Guild of Necrophagous Flies. *Ann. Entomol. Soc. Am*. 68 (1975) 741-754.
34. R. F. Denno, W. R. Cothran, Competitive interactions and Ecological strategies of Sacophagid and Calliphoid Flies inhabiting rabbit carrions. *Annual Entomological Society of America* 69 (1986) 109-113
35. B. L. Torban, *Butterfly of West Africa.* Appolo Books, Kirkeby Sand 19, Dk 5771 dtenstrup, Denmark (2005).
36. N. F. Shaumar, S. K. Mohammad, N. M. Salem, Taxonomic studies of Dermestidae (Coleoptera) in Egypt. *J. Bull Soc. Entomol. Egypt*. 69 (1990) 11-12
37. J. F. Lawrence and A. F. Newton Jr, Evolution and classification of beetles. *Annual Review of Ecology and Systematics* 13(1982) 261–290 https://doi.org/10.1146/annurev.es.13 .110182.001401
38. M. L. Almeida, K. M. Mise, Diagnosis and keys to the main families and species of South America Coleoptera of Forensic important. *Revista Brasileiva de Entomology* 53(2) (2009) 227-244) https://doi.org/10.1590/S0085-56262009000200006
39. A. G. Radchenko, Review of Ants of the Genus *Cataglyphis Foerster* (Hymenoptera; Formicidae) of Asia. [In Russian.]. *Entomol. Obozr*. 76(1997) 424-442
40. S. Bolton, *Identification Guide to the Ant's Genera of the World*. Harvard University Press, Cambridge, MA (1994). 222.
41. B. Bolton, G. Alpert, P. S. Ward, P. Nasrecki Bolton's Catalogue of Ants of the World. Harvard University Press, Cambridge, ISBN-10: 9780674021518, Massachusetts. 3658
42. T. Ekrakene, P.E. Odo, Comparative developmental effects of tramadolhydrochloride and Cypermethrine on *Chrysomya albiceps* (Dipera: Calliphoridae) reared on rabbit carrion. *Science world Journal* 12 (1) (2017) 28-32. ISSN 1597-6343.
43. R. Tuduo, P. E. Odo, T. Ajemitolu, O.H. Chidi, Carrion decomposition and Arthropods fauna recovered on the decomposing Guinea pig (*Cavia porcellus*) carrion at the College of Education Warri, Warri South LocalGovernment Area, Delta State, Nigeria. A paper presented at the Fifth Delta State University Faculty of Science International Conference on 7th – 10th October (2019)
44. M. L. Goff, Estimation of postmortem interval using arthropod development and successional patterns. *Forensic Science Review*, 5 (1993) 81-94.