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Impact of Sunlight Exposure on the Diversity and Succession of Insects Associated with Strangulated Juvenile Pig Carcasses

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***Abstract*—**Decomposition of carcasses is a continuous process that is mostly associated with successional invasion by arthropods, insects in particular. Application of these successional patterns can be of immense use in forensic investigations. But limited data with regards juveniles particularly in developing countries exist, informing the need for this study. Two juvenile pigs of 10kg mean weight were killed by strangulation at the Research Garden of Biological Sciences Department of Federal University Wukari and monitored till the dry stage of decomposition. The specimens which were kept about 25m apart, having one under a tree shade and the other left exposed. Both were protected from vertebrate scavengers using metal cages, while daily sampling for adult arthropods was done using a combination of sweep net, pitfall traps and manual picking. Daily collections of invading arthropods using the different techniques were pooled and the data used to compute relative abundance (RA) and frequency of occurrence (FO) on each specimen. Taxa with FO ≥ 25% and RA ≥ 1% were regarded as dominant species. Diversity indices were computed using Paleontological Statistical Tool ($Past_3$). Results of the study showed that both carcasses completed decomposition in 14 days of which a total of 781 arthropods were sampled from the exposed carcass, with *Hister monitor, Dermestes maculatus, Zophosis* sp., *Chrysomya chloropyga* and *Pheidole* sp. as dominant insects while 816 arthropods with an addition of *Camponotus perrisii* and *Camponotus maculatus* to the aforementioned were dominant on the shaded carcass. Slight differences were observed in the duration of the active and dry decomposition stages of both carcasses but at the end, while the shaded carcass was left with dried leathery skin, the exposed carcass mummified wholly. Although the analysis of species similarity for both total sampled species and dominant species showed a > 50% species similarity for both carcasses, the successional pattern of *C. chloropyga* (the most dominant species) on both carcasses showed a clear variation. Thus, differences in species composition, decompositional stages, postmortem changes as well as succession of *C. chloropyga* may largely be dependent on the effect of sunlight exposure on the carcasses.

Keywords— Decomposition, succession, sunlight exposure, juvenile pig, insects

I. INTRODUCTION

Decomposition of carcasses occur in five distinct stages used to describe the physico-chemical alterations that takes place in the carrion, *viz;*fresh or early, bloated, active decay, advanced decay and dry remain stages [1]. Different arthropod species particularly insects associate with each of the decompositional stage of carcasses in a successional manner and performs different ecological roles such as predatory, necrophagic, saprophagic, coprophagic, and phytophagic roles among others, thereby facilitating the rate of decomposition of carcasses [2, 3]. The successional pattern by which these insects invade carrion is important in determining the minimum post mortem interval PMI_{min} of the carcass which is an integral factor in death investigations [3]. Insect invasion of a carrion *viz-a-vis* the rate of decomposition can be influenced by factors such as geographic region, exposure status, cause of death, climate, body mass of carrion, among others [4]. Hence, data base of local origin which are mostly obtained using pig models is important in forensic entomology and other medico-legal investigations particularly, as it relates human cadaver.

Strangulation is reported as the second most commonly used method of homicide and juveniles and women are largely the major victims [5, 6]. Hardly however, has any forensic entomological study related to strangulation juveniles been documented in Africa and particularly, Nigeria. Hence, this study is aimed at filling this knowledge gap by evaluating the effect of sunlight exposure status on the diversity and successional pattern of cadaverous arthropods, insects in particular associated with strangulated juvenile pig carcasses in the study area.

II. METHODOLOGY

Study Area

The study was carried out in the Research Garden of Biological Sciences Department of Federal University Wukari, Nigeria. Wukari Local Government Area is a

Southern guinea savanna zone situated on a 4,308 km^2 land area, having an altitude of 187m above sea level, average temperature of 26.8^oC and an average annual rainfall of 1205mm. It is a semi-urban environment which lies between latitude 7.89N and longitude 9.77E [7].

Acquisition and Preparation of Specimen

Observing the principles of replacement, reduction and refinement (the 3Rs), two juvenile pigs of 10kg average weight were purchased from a pig farm in Wukari town and killed by strangulation. Each pig was kept at 25m distance apart, having one of the pigs placed under a tree shade and the other exposed to sunlight for the period of the study. Each of the pigs was placed on a metal mesh and covered with a metal cage that screened off avian and vertebrate intruders [8].

Insect Sampling and Identification

Adult insects invading the carcasses were sampled using same sampling intensity from fresh- to dry–remain stage of decomposition of the carcasses between 2pm and 6pm daily, using sweep nets (two standard sweeps) for flying insects and a combination of pitfall trap and manual searching and picking for ground insects [9, 10]. Insect presence and abundance, physical changes of carcasses as well as odour intensity constituted the daily collected data throughout the study period [10]. All insects sampled from both carcasses were taken in collecting bottles containing 70% alcohol to the Biological Science Laboratory of Federal University Wukari, sorted and identified as morphospecies. Representative samples were sent to the insect museum of Institute of Agricultural Research (IAR) in Ahmadu Bello University (ABU) Zaria, Nigeria for confirmation.

Data Analysis

Data on insect abundance using the various sampling methods were collated and used to compute the frequency of occurrence (FO) and relative abundance (RA) of both carcasses throughout the decomposition stages. Taxa with FO ≥ 25% and RA ≥ 1% were regarded as dominant species and were categorized into feeding guilds while, those with FO < 25% and/or RA < 1% were regarded as rare species as described by [11] and were placed in their respective feeding guilds, while species diversity (H), richness (R) and evenness (H) were computed for the different decomposition stages, using the Paleontological Statistical Tool – $Past_3$ [12]. In addition, the Jaccard's similarity index modeled below was used to determine the similarity of the insects in the distinctive environments:

$$Jaccard\ index = X \cap Y / X \cup Y \times 100$$

Where:

X∩Y = Number in both sets,
X∪Y = Number in either set.

III. RESULTS AND DISCUSSION

Both the exposed and shaded carcass completed decomposition in 14 days. Although both carcasses were observed to have gone through the fresh and bloated stages within the first 2-days, their active decay, advance decay and dry stages differed. For the exposed carcass, the active decay stage lasted from Day 3 – 4 while same process for the shaded carcass was observed only on Day 3. The advance decay stage of both carcasses lasted for 2-days, respectively. But while the process occurred from Day 5 – 6 in the exposed carcass, it was observed from Day 4 – 5 in the shaded carcass. For the dry-remain stage; it was observed to have lasted longest in both carcasses. But while it was observed from Day 7 – 14 on the exposed carcass, the process commenced from Day 6 – 14 on the shaded carcass (Tables 1 and 2). Furthermore, both carcasses were observed to have soft skin and flexible limbs with no odour at the fresh stage and an inflated head and abdomen with intense odour at the bloated stage. At the active decay stage, the exposed carcass was observed to release lots of body fluid from the mouth, abdomen and rectal region with a slight peeling of the skin and an intense odour. While for the shaded carcass, the abdomen was observed to have burst open, thereby exposing the intestinal tissues with intense odour (Tables 1 and 2).

At the advanced decay stage, the body fluid of the exposed carcass was observed to have dried up as the skin also becomes drier. While for the shaded carcass, extensive peeling of the skin accompanied by massive loss of body hair was observed as the skin got drier. Although odour was present for both carcasses, it was not intense. For the dry stage, both carcasses notably showed dryness of the skin. But while the exposed carcass rather mummified, the shaded carcass lost most of its body hair and had a good portion of its bones exposed (Tables 1 and 2).

Table 1 shows that *Chrysomya chloropyga* (Calliphoridae – Diptera) and *Hister monitor* (Histeridae – Coleoptera) colonized the carcass at the fresh stage and persisted till the dry-remain stage. At the bloated stage, *Zophosis* sp. was sampled from the carcass and continued till the dry stage, while *Dermestes maculatus* (Dermestidae – Coleoptera) and *Pheidole* sp. (Formicidae – Hymenoptera) were sampled from the active decay to dry remain stage alongside the aforementioned species. On the shaded carcass, Table 2 shows that *C. chloropyga* and *Zophosis* sp. were the first dominant colonizers at the fresh stage and also persisted throughout the decomposition stages except for the advanced decay stage where *C. chloropyga* was not sampled. At the bloated stage, *H. monitor*, *D. maculatus*, *Camponotus perrisii* and *Camponotus maculatus* (Formicidae – Hymenoptera) were recorded among the dominant species invading the carcass and were sampled throughout the decomposition stages. While *Pheidole* sp. was sampled at both the advanced and dry stages, *Anochetus* sp. (Formicidae – Hymenoptera) was sampled only at the dry stage.

Table 1. Physical Changes on Decomposing Strangulated Juvenile Pig Carcass Exposed to Sunlight

Stages of decomposition	Period (days)	Sampling time	Physical changes	Odor presence and intensity	Dominant species
Fresh (day 0 - 1)	1	2.00 pm – 6.00 pm	Flexible limbs	None	*C. chloropyga and H. monitor*
Bloated (day 2)	1	2.00 pm – 6.00 pm	Swelling of the abdomen and head region, slight greenish change in colour	Present and intense	*Hister monitor,Zophosis* sp., *and C. chloropyga*
Active Decay (day 3 - 4)	2	2.00 pm – 6.00 pm	Release of body fluid from, mouth, abdominal and rectal regions, slight deflation of the body, gradual peeling of the skin.	Present and intense	*Hister monitor, D. maculatus, Zophosis* sp., *C. chloropyga and Pheidole* sp.
Advanced Decay (day 5 - 6)	2	2.00 pm – 6.00 pm	Skin getting drier with reduced release of body fluid	Present but not intense	*Hister monitor, D. maculatus, Zophosis* sp., *C. chloropyga and Pheidole* sp.
Dry Remain (day 7 - 14)	8	2.00 pm – 6.00 pm	No moisture on skin, skin very dry and mummified	Present but not intense	*Hister monitor, D. maculatus, Zophosis* sp., *C. chloropyga and Pheidole* sp.

Table 2. Physical Changes on Decomposing Strangulated Juvenile Pig Carcass Shaded from Sunlight

Stages of decomposition	Period (days)	Sampling time	Physical changes	Odor presence and intensity	Dominant species
Fresh (day 0-1)	1	2.00 pm – 6.00 pm	Flexible limbs and soft body	None	*C. chloropyga and Zophosis* sp.
Bloated (day 2)	1	2.00 pm – 6.00 pm	Swelling of the abdomen and head region, slight greenish change in colour	Present and intense	*Hister monitor, D. maculatus, Zophosis* sp., *C. chloropyga, C. perrisii, and C. maculatus*
Active Decay (day 3)	1	2.00 pm – 6.00 pm	Abdomen bursts to expose intestinal tissues, deflation of the body, gradual peeling of the skin, loss of body hair.	Present and intense	*Hister monitor, D. maculatus, Zophosis* sp., *C. chloropyga, C. perrisii, and C. maculatus*
Advanced Decay (day 4-5)	2	2.00 pm – 6.00 pm	Exposure of ribs, extensive peeling of skin and loss of hair, dismembering of digits, skin getting drier	Present but not intense	*Hister monitor, D. maculatus, Zophosis* sp., *C. perrisii, C. maculatus and Pheidole* sp.
Dry Remain (day 6 - 14)	9	2.00 pm – 6.00 pm	Skin very dry	None	*Hister monitor, D. maculatus, Zophosis* sp., *C. chloropyga, C. perrisii, Anochetus* sp., *C. maculatus and Pheidole* sp.

Halting of physiological changes in dead animals deteriorates the organism thereby leading to putrefaction which is usually accompanied with invasion of different species of arthropods [3, 13]. Carrion decomposition as also witnessed in this study, is reported to be a continuous process with 5 – progressive stages, characterized by different postmortem observable changes *viz-a-vis* invading carrion entomofauna. The decomposition process of the exposed and shaded carcasses used for this study lasted for 14 days, buttressing the report of [14] for fast decomposition of low body weight pigs. Each of the carcasses was seen invaded by different arthropod species especially insects at various decomposition stages. Although some insect species occurred throughout the decomposition stages, a breakdown of their daily abundance for some of the stages clearly shows a transition to/from high abundance.

At the early/fresh stage of decomposition of both carcasses used for this study which lasted from day 0 – 1, both carcasses were predominantly invaded by a Calliphorid (*C. chloropyga*), with flexible limbs and soft skin as their observable postmortem features. This finding aligns with the report of [3] who reported blowflies dominating carcasses at this stage as well as the corresponding postmortem feature. The bloated stage of the carcasses was observed on day – 2 as also reported by [3]. This stage for both carcasses lasted for 1 day but had increase in invading insect species. One - day bloated stage as observed in this study agrees with those of [15, 16] and is characterized by inflation of the abdomen and head regions as well as slight greenish change in colour. At this stage, the exposed carcass was additionally colonized by two coleopteran species (*H. monitor* and *Zophosis* sp.) alongside the initial colonizer (*C. chloropyga*) while the shaded carcass had three coleopteran species (*H. monitor, Zophosis* sp. and *C. chloropyga*) and a hymenopteran (*C. maculatus*) as

additional colonizers alongside *C. chloropyga*. Inflation of body as well as colour change as observed at the bloated stage of this study for both carcasses agrees with documented reports for same observable postmortem changes of carcasses at this stage [1, 3, 10], while the invading entomofauna at this stage also agrees with the reports of [14].

A total of 780 identified insects from 11 different species, across 11 families were sampled from the exposed carcass. As shown in Table 3, *Pheidole* sp. had the largest abundance (510), constituting about 65% of the total sampled insects, distantly following by *H. monitor* (78) and *C. chloropyga* (77), while *Ommatius* sp. (Asilidae – Diptera) had the least abundance (1), constituting 0.13% of the total sampled insects. Although *Pheidole* sp. had the largest abundance and RA, its FO (78.57%) was next to that of the coleopterans (*D. maculatus* and *Zophosis* sp.) with 85.71% respectively, while *Ommatius* sp. and *M. domestica* had the least FO of (7.14%), respectively.

On the other hand, a total of 811 insects from 16 different species, across 11 families were sampled from the shaded carcass (Table 4). *C. chloropyga* had the highest abundance (219) and RA (26.84%), closely followed by *Anochetus* sp. and *H. monitor* with abundance of 200 and 105 and RA of 24.51 and 12.87%, respectively, while *Ommatius* sp. and *Gymnogryllus lucens* (Gryllidae – Orthoptera) had the least values for abundance (1) and RA (0.12%) as shown in Table 4. The FO of *D. maculatus* was 85.71% followed by 57.14% for *Zophosis* sp. and *C. perrisii*, respectively. *Ommatius* sp. and *G. lucens* had the least FO of 7.14%, respectively.

Table 3: Abundance, Relative abundance and Frequency of occurrence of arthropods associated with strangulated juvenile pig carcass exposed to sunlight

Order	Family	Genus/species	Decomposition stages and No. of days																
			Fresh	Bloated	Active Decay		Advance Decay		Dry Stage								ABD	RA (%)	FO (%)
			Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14			
Arachnida	Araenae	***	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0.13	7.14
Coleoptera	Histeridae	*Hister monitor*	2	8	4	17	7	14	2	4	0	0	0	0	0	0	58	7.43	57.14
	Dermestidae	*Dermestes maculatus*	0	0	4	5	10	7	3	2	5	10	8	16	5	3	78	10.00	85.71
	Tenebrionidae	*Zophosis* sp.	0	2	4	2	3	10	5	1	5	2	1	0	1	3	39	4.99	85.71
	Cleridae	*Korynetes analis*	0	0	0	0	0	1	0	0	0	0	2	0	0	0	3	0.38	14.29
	Curculionidae	*Sclerocardius* sp.	0	0	0	0	0	0	2	1	0	0	0	0	0	0	3	0.38	14.29
Diptera	Calliphoridae	*Chrysomya chloropyga*	11	10	23	19	8	5	0	1	0	0	0	0	0	0	77	9.86	50
	Syrphidae	*Mesembrius* sp.	1	0	0	2	0	2	0	0	0	0	0	0	0	0	5	0.64	21.43
	Muscidae	*Musca domestica*	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0.38	7.14
	Asilidae	*Ommatius* sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0.13	7.14
Hemiptera	Alydidae	*Stenocoris southwoodi*	0	0	0	0	0	0	0	2	0	0	0	0	0	1	3	0.38	14.29
Hymenoptera	Formicidae	*Pheidole* sp.	0	0	0	13	5	5	5	3	6	43	16	140	66	208	510	65.30	78.57
Total																	**781**	**100**	

(***) = Unidentified spider species, ABD = Abundance, RA = Relative abundance, FO = Frequency of occurrence.

Table 4: Abundance, Relative abundance and Frequency of occurrence of arthropods associated with strangulated juvenile pig carcass shaded from sunlight

Order	Family	Genus/species	Decomposition stages and No. of days																
			Fresh	Bloated	Active Decay	Advance Decay		Dry Stage									ABD	RA (%)	FO (%)
			Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14			
Arachnida	Araenae	***	0	0	0	0	2	1	1	0	0	0	1	0	0	0	5	0.61	28.57
Coleoptera	Histeridae	*Hister monitor*	0	5	19	42	18	10	5	5	0	0	1	0	0	0	105	12.87	57.14
	Dermestidae	*Dermestes maculatus*	0	2	3	14	12	3	2	7	0	2	4	2	4	2	57	6.99	85.71
	Tenebrionidae	*Zophosis* sp.	1	2	3	12	3	4	3	1	0	0	0	0	0	0	29	3.55	57.14
	Cleridae	*Korynetes analis*	0	0	1	0	1	0	1	0	0	0	0	0	0	0	3	0.37	21.43
	Staphylinidae	*Philonthus* sp.	0	0	0	1	0	1	1	0	0	0	0	0	0	0	3	0.37	21.43
	Curculionidae	*Sclerocardius* sp.	0	0	0	0	0	4	1	2	0	0	0	1	0	0	8	0.98	28.57
	Tenebrionidae	*Endustomus senegalensis*	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2	0.25	14.29
Diptera	Calliphoridae	*Chrysomya chloropyga*	16	57	73	0	0	0	0	0	0	14	27	10	22	0	219	26.84	50
	Syrphidae	*Mesembrius* sp.	1	1	5	0	0	0	0	0	0	0	0	0	0	0	7	0.86	21.43
	Muscidae	*Musca domestica*	0	0	4	4	0	0	0	0	0	3	0	0	0	0	11	1.35	21.43
	Asilidae	*Ommatius sp*	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.12	7.14
Hymenoptera	Formicidae	*Camponotus perrisii*	0	2	12	9	28	5	2	1	1	0	0	0	0	0	60	7.35	57.14
	Formicidae	*Anochetus* sp.	0	0	0	0	0	0	0	0	0	0	0	113	51	36	200	24.51	21.43
	Formicidae	*Camponotus maculatus*	0	16	4	0	8	0	0	4	0	0	1	0	0	0	33	4.04	35.71
	Formicidae	*Pheidole* sp.	0	0	0	5	5	12	5	0	0	31	10	4	0	0	72	8.82	50
Orthoptera	Gryllidae	*Gymnogryllus lucens*	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.12	7.14
Total																	**816**	**100**	

(***) = Unidentified spider species, ABD = Abundance, RA = Relative abundance, FO = Frequency of occurrence.

The active decay stage of the exposed carcass occurred within 2 – days (day 3 – 4) while that of the shaded carcass occurred only on day – 3, corroborating the report of [9]. At this stage, the exposed carcass was observed to release some fluid from both its abdominal surface and the orifices, accompanied by slight sagging of the skin. The shaded carcass had bursted abdomen with exposed intestinal and loss of body hair. The release of body fluid and slight sagging of skin as observed with the exposed carcass has been reported [3] for exposed carcasses at this stage while the postmortem changes as observed for the shaded carcass, agrees with the reports of [1, 3] for shaded carcasses at same stage of decomposition. Abundance of invading insects also heightened for both carcasses at this stage but the exposed carcass had lower number of species (6) invading it than the shaded carcass which had 9. Sun intensity as a result of the exposure status of the exposed carcass would have been a major factor to the reduction of associated insect species, prolonged active decay stage as well as the difference in observable postmortem changes between both carcasses.

Three insect orders *viz;* coleoptera, diptera and hymenoptera constituted the dominant insect orders sampled from both carcasses with abundance of 181, 86 and 510 for the exposed carcass and 207, 238 and 365 for the shaded carcass, respectively. Analysis of the diversity indices showed a consistently higher values for dipterans with respect to both carcasses for diversity (H = 1.28 and 1.33), evenness (E = 0.72 and 0.76) and richness (R = 0.90 and 0.73). Correspondingly, hymenopterans of both carcasses consistently showed the least values for same indices (H = 0.21 and 0.78; E = 0.41 and 0.55; R = 0.32 and 0.51). Comparing both carcasses, the shaded carcass generally has greater values for diversity and evenness than the exposed carcass, while for species richness, the exposed carcass has greater value than the shaded carcass as shown in Tables 5a and 5b.

Table 5a. Diversity indices of dominant insect orders invading exposed strangulated juvenile pig carcasses

	Exposed Carcass		
Stages/Order	**Coleoptera**	**Diptera**	**Hymenoptera**
Fresh	2	12	0
Bloated	10	10	0
Active Decay	36	44	13
Advanced Decay	52	18	10
Dry Remain	81	2	487
Total	181	86	510
Shannon (H)	1.25	1.28	0.21
Evenness (E)	0.70	0.72	0.41
Richness (R)	0.77	0.90	0.32

Table 5b. Diversity indices of dominant insect orders invading shaded strangulated juvenile pig carcasses

	Shaded Carcass		
Stages/Order	**Coleoptera**	**Diptera**	**Hymenoptera**
Fresh	1	17	0
Bloated	9	58	18
Active Decay	26	82	16
Advanced Decay	103	4	55
Dry Remain	68	77	276
Total	207	238	365
Shannon (H)	1.14	1.33	0.78
Evenness (E)	0.62	0.76	0.55
Richness (R)	0.75	0.73	0.51

Analysis of sampled and dominant species similarity of both the exposed and shaded carcasses using the Jaccard's similarity index showed high species similarity of above 50% between both carcasses as showed in Table 6.

Table 6. Jackard's similarity index of both sampled and dominant insect species collected from exposed/shaded strangulated Juvenile pig carcasses

Description	**All sampled species**	**Dominant species**
/Exp ∩ Shd/	10	5
/Exp U Shd/	17	8
Jackard similarity (%)	58.8	62.5

/Exp ∩ Shd/ = similar species shared by both carcasses.
/Exp U Shd/ = total number of sampled species.

The advanced stage of both carcasses used in the study lasted for 2 – days each. But while the process was observed from day 5 – 6 on the exposed carcass, same process occurred from day 4 – 5 on the shaded carcass. Postmortem changes observed from the exposed and shaded carcasses used in this study also showed variation. Shrinking of skin accompanied with dryness was observed for the exposed carcass while massive hair loss, extensive peeling of skin and gradual dryness was observed for the shaded carcass. Shrinking and dryness of skin as observed for the exposed carcass in this study buttresses the report of [3] for exposed carcass while the postmortem changes observed for the shaded carcass also agrees with those of [10]. Although both carcasses had coleopteran (Histeridae, Dermestidae and Tenebrionidae) and hymenopterans (Formicidae) as the dominant invading insects, dipterans (Calliphoridae and Syrphidae) were clearly absent for the shaded carcass at this stage while they occurred on the exposed carcass. The presence of the aforementioned coleopteran, dipteran and hymenopteran families on carcasses at this stage have been reported [10, 14] but while [10] reported absence of *C. chloropyga* at this stage only for wet season, the finding in this study which reports same for dry season on the shaded carcass appears to be contradictory.

As showed in Table 7, *H. monitor* was observed to play both predatory and saprophagic roles on both carcasses, *D. maculatus* and *C. chloropyga* were exclusively necrophagous, *Zophosis* sp. was exclusively predaceous while all the dominant Formicids sampled were observed to be both predaceous and phytophagous.

Table 7. Feeding guild of dominant insects invadingexposed/shaded strangulated juvenile pig carcasses

Order	Family	Genus/ Species	Sampled Carcass	Feeding Guild
Coleoptera	Histeridae	*H. monitor*	Both	Predaceous/ Saprophagous
	Dermestidae	*D. maculatus*	Both	Necrophagous
	Tenebrionidae	*Zophosis* sp.	Both	Predaceous
Diptera	Calliphoridae	*C. chloropyga*	Both	Necrophagous
Hymenoptera	Formicidae	*Pheidole* sp.	Both	Predaceous/ Phytophagous
	Formicidae	*C. perrisii*	Shaded	Predaceous/ Phytophagous
	Formicidae	*Anochetus* sp.	Shaded	Predaceous/ Phytophagous
	Formicidae	*C. maculatus*	Shaded	Predaceous/ Phytophagous

At the dry stage of decomposition, both carcasses had very dried skin with the exposed carcass completely mummified while the shaded carcass was leathery. This stage which lasted from day 7 – 14 in the exposed carcass and day 6 – 14 in the shaded carcass saw a drastic reduction in invading carrion insects. Having *D. maculatus, Zophosis* sp. and *Pheidole* sp. as dominant species for the exposed carcass, the shaded carcass had *D. maculatus, C. chloropyga, Anochetus* sp. and *Pheidole* sp. as dominant species. Notable observation of this stage on both carcasses is the seemingly large return of *C. chloropyga* imagoes accompanied by heavy invasion of *Anochetus* sp. on the shaded carcass while for the exposed carcass, dipterans (*C. chloropyga*) were clearly absent. Reduction in invading species abundance at the dry stage has been reported [10]. Differences in the successional pattern of dipterans especially *C. chloropyga* on both carcasses may largely be as a result of the effect of sunlight exposure on both carcasses.

IV. CONCLUSION

The effect of sunlight exposure was observed to affect the duration of the decomposition stages especially for the active and dry stages of both carcasses. Also, the whole mummification of the exposed carcass against the normal dryness observed on the shaded carcass as well as the alteration in successional pattern of dipterans on both carcasses can largely be attributed to the sunlight exposure status of the carcasses. Although few differences exist in species composition of both carcasses with more formicids invading the shaded carcass than the exposed, both carcasses were observed to have above 50% species similarity.

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