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Field succession study of necrophagous arthropod fauna of rat (*Rattus norvegicus* Linnaeus, 1769 var wistar) carrion exposed on natural environment at Nsimalen neighborhood, Yaounde-Cameroon

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Abstract
This study investigated the succession of necrophagous arthropod fauna on rat (*Rattus norvegicus* var. Wistar) carrion in a natural environment at Nsimalen, Yaoundé, Cameroon, to contribute to forensic entomology. Four rat carcasses were exposed, and insect activity was monitored from November 2020 to February 2021. The decomposition process was categorized into five stages: fresh, bloated, decay, dry, and skeletonized, lasting 91 days in total. A total of 803 necrophagous arthropods were recorded, dominated by insects, particularly Diptera (97.51%), followed by Coleoptera (1.87%). *Lucilia illustris*, *Chrysomya vanemdeni*, and *Tricharaea sp.* were among the most abundant species. The findings demonstrate the importance of understanding local necrophagous insect fauna in forensic applications, emphasizing the need for further research to expand forensic entomology knowledge in Cameroon.

Keywords: Cameroon, forensic entomology, carrion, arthropod and decomposition

1. Introduction
Forensic entomology deal with the information gathered from the study of necrophagous insect and it's relative and hang to justice by the entomologist during the crime case. It can also be defined as the use of necrophagous insects and other arthropods as proof in court during legal investigations. Based on the above mention fauna, the key application of this science is the determination of post mortem interval (P.M.I.) but his estimation governed by the strong knowledge of the local necrofauna witch is influence by the abiotic and biotic parameters (Rochefort *et al*., 2015) [10]. During the process of corpse decaying, arthropods as well as other decomposers participate actively alongside the environmental parameters to the process of decomposition of the cadaver. Amongst these decomposers, insects are the most diverse group of animals worldwide estimated at over 5,5million species worldwide (Prado e Castro and Ameixa, 2021) [6]. There is a huge number of unexplored or underexplored species of insect that may develop knowledge about forensic entomology in
Africa whereas these organisms are for the great importance, not only for the degradation process, but also for forensic purposes, since they are usually the first to colonize the corpse after death (Maisonhaute and Forbes, 2020) [5]. They can provide an excellent source of evidence for forensic entomologists, judiciary system during inquiries and are also relevant to problems in public health, medicine, and animal health (Lutz *et al*., 2017) [3].
According to Anderson (2009 and 2020) [2, 53], Lutz *et al*. (2019, 2023) [4, 55] and Smith *et al*. (2023) [52], the decomposition process, its duration, and the structure of the arthropod community associated with cadaver can greatly vary based on geographic location and climate. Although blow flies are reported to be the first to colonize a cadaver, the species involved differ according to the region. Anderson (2020) [53] emphasize that the time of colonization of a specific insect family can also differ according to geographic location, justifying why it is important to perform local experiments to identify the local necroentomofauna involved in the alteration process, and to determine precisely the colonization sequence of each family/species in relation to the decomposition stages. There is a possibility to find species which may offer different advantages in relation to the ones currently accepted (Duarte *et al*., 2021).

Knowing that forensic entomology is the exploitation of the result gathered from the study of insect or others relative organism collected on and around the death body to help solve crime during criminal investigation, knowledge of the distribution, biology, ecology and behavior of these organism can provide information on when, where and how a crime was committed (Erzinçlioglu, 2000; Goff, 2000; Byrd and Castner, 2001; Greenberg and Kunich, 2002; Amendt *et al*., 2004, 2007 and Feugang Youmessi *et al*., 2012a, b and 2021) [40, 45, 39, 46, 4, 48].

As argue by Kurahashi and Kirk-Springgs (2006) [13] and Zaime and Gautier (1989), the richest fauna is probably that of the Afrotropical region, with almost 340 valid species in 40 genera. This afrotropical fauna includes some of the most important species of diptera, in terms of medical, veterinary and forensic significance (Kurahashi and Kirk-Springgs op. cit. and Pont, 1980). The necrofauna of Cameroon have rarely been studies and are poorly documented. This specific fauna maybe a mixture of all the Central Africa sub-region according to the environmental conditions found within this country. There is very little information on the diversity, biology and distribution of forensic insect in Cameroon (Braet *et coll*., 2012). Therefore, the behavior, the life cycle and the composition of these flies are unknown in Cameroon. Few information known about them are limited to few species that are restricted to the center region of the country specifically within the University of Yaounde 1 campus where Feugang Youmessi *et al*. (2012a, 2012b, 2021) [48], Feugang Youmessi (2023) [48] and Feugang Youmessi and Djonga (2024) [48] conducted some preliminary research on necroentomofauna of *Rattus norvegicus* (Berkenhout, 1769) based on the inventories and one identification key.

2. Material and Methods

2.1 Study site: The present research work was carried out from 19 November 2020 to 14 February at the southern entrance of Yaounde, specifically at Nsimalen (11°33'01''E 3°51'35''N) which hosted an estimated population of about 3000 inhabitants. Yaounde town has been urbanized quickly as well as the demography growth with increasing of violent crimes as consequence. According to Suchel (1988) and Kengne Fodouop and Atangana (2010), the climate is equatorial characterized by a specific climate call "Yaoundean climate" characterized by four seasons: two dried seasons and two wait seasons: a long rainy season from mid – November to February, a short rainy season from March to June, a short dry season from July to August and a long rainy season from September to mid –November. Also, based on the data from Yaounde meteorological station and that of our data logger Testo 174, the average climatological values of annual mean temperature fluctuated between 23 and 24°C and the precipitation varied between 1500 and 2000 mm (Suchel, 1988; Kengne Fodouop and Atangana, op.cit.). The landscape of the study site is suburban and characterized by the presence some common trees like *Elaeis guineensis* (Arecaceae) and *Musa* sp. (Musaceae).

The experimental set up was situated at the third floor of an abandon house yet to be finished with twenty (20H) hours of sunny daily and away from anthropological activities and scavengers.

2.2 Methods

2.2.1 Biological substractum

For our experiment, four rats (*Rattus norvegicus*, Berkenhout, 1769) carcasses of the same size weighting 1,5 kg were used for experiement. After the verification for health, these animals were euthanasized by cervical dislocation (Shaalan *et al*., 2017) [54] before been kill by a veterinarian (Kpama-Yapo Yapibié *et al*., 2021) [35] following all sacrified-related process as to give good animal care, reduce suffer and stress. The rat carcasses were placed immediately inside a wooden cage covered all side with a metallic wire mesh (2 x 2 cm) to prevent interference from vertebrate scavengers like carnivorous animals and people curiosity while allowing the necroentomofauna to be continuously acting on the corpse which continue naturally his cadaveric decaying process (Feugang Youmessi, 2023; Feugang Youmessi and Djonga) [48].

2.2.2 Sampling protocol

The necroentomofauna was caught using three complementary procedures: the adult flies were collected directly using a hand net, the adult that cannot fly were pick directly with flexible pliers and others small insect were caught using 4 pittfall traps placed around the corpse at the head, the left and ride side of the body and at the legs level at the distance of 10 cm.

As performed by Midgley and Villet (2009 and 2021) and Williams *et al*. (2021) [3], the traps were checked regularly, the necroentomofauna were harvested daily on and around the carcasses, using soft pliers, temporary stored in labeled pills containing 70% ethanol which is the preferred methods for preserving forensic samples of insect then taken back to the laboratory of Zoology of the Department of Animal Biology and Physiology, Faculty of sciences of the University of Yaounde 1 for later identification.

All harvested necroentomofauna was identified to various level of taxonomy using binocular stereomicroscope and various dichotomic keys (Whitworth, 2010; Feugang Youmessi *et al*., 2012b; Irish, 2014; Kurahashi Hiromu and kirk-Spriggs, 2006) and Rochefort *et al.* 2015) [49, 10, 19, 13, 10].

The measurement of temperature and relative humidity was donned using data logger Testo 174 (Yapo *et al*., 2017) [42].

3. Results

3.1 Carcass decomposition: The observation of the morphological/physical modifications appears on the carcass enable us to determine five stages of the decomposition namely and successively the fresh, the bloated, the decayed, the dried and the skeletonize stages.

The observation showed no physical/morphological changes on the carcasses during the fresh stage with lasted 48 hours (from day 1 to day 2) though in day 2, maggots were observed, odours were faintly noticeable nearby the corpse.

The duration of the bloated stage was from day 3 to day 4 where both swelling and deflation of the carrion were chronologically notice. The smelt of the death rat was strong and even noticeable five (5) meters away.

During the third (3^{th}) alteration phase named decayed stage which lasted from day 5 to day 10, the inwards of the carcass were completely devoured by the larvae which migrated from the corpse to the beneath soil immediately after their satiation. This putrefaction phase stopped with the entire disappearance of viscera alongside the larvae migration.

Within the dried stage stayed from day 11 to day 60 when the decay stopped, only hairs, cartilage, bones, nails, teeth and skin resist from the degradation. The skin started to split on day 14 while hair and bones were already delocalized except on some joint/articulation.
The skelotonized phase started from day 61 to the end at day 91 when we stopped the field trip. It's was characterize by only dried pieces of skin and bones observed on the soil at the study site.

3.2 Necrophagous fauna composition
A total of 803 individuals associated with carrion were census throughout all the field experiment (table 1). The diversity analyzing of the fauna yields two classes including 1 (0.12%) diplopoda and 802 (99.88%) insecta, four orders with 1 (0.12%) glomerida, 4 (0.50%) lepidoptera, 15 (1.87%) coleoptera and 783 (97.51%) diptera giving them as the most diverse order following by coleoptera, lepidoptera and lastly glomerida.

3.2.1 Order diptera
Among the diptera gathered during the whole experiment, the most richess (515 (64.14%) and most diverse (14) family was calliphoridae hosted 176 (21.92%) *Lucilia illustris*, 107 (13.33%) *Chrysomya vanemdeni*, 46 (5.73%) *Hemipyrellia* sp., 42 (5.23%) *Hemipyrellia fernandica*, 37 (4.61%) *Lucilia sericata*, 36 (4.48%) *L. silvarum*, 23 (2.86%) *Chrysomya megacephala*, 21 (2.62%) *C. putoria*. Then came *Lucilia ampullacea*, *Phumosia* sp., *Tricyclea* sp., *Lucilia caesar*, *Chrysomya albiceps* and *Chrysomya* sp. with 7 (0.87%), 6 (0.75%), 4 (0.50%) and 1 (0.12%) respectively (Table 1).
The second most abundant and diverse families where 141 (17.56%) sarcophagidae and 81 (10.09%) muscidae with six taxa each. Sarcophagidae were made up of 76 (9.46%) *Tricharaea* (*Sarcophagula*) sp., 44 (5.48%) *Sarcophaga* sp., 16 (1.99%) *Sarcophaga africa*, 2 (0.25%) *S. zumpti*, 2 (0.25%) *Ravinia belforti* and 1 (0.12%) *Ravinia pernix*. Muscidae brought together 30 (3.74%) *Ophyra* sp., 29 (3.61%) *Hydrotaea* sp., 9 (1.12%) *Atherigona* sp., 7 (0.87%) *A. orientalis*, 5 (0.62%) *Sarcopromusca pruna* and 1 (0.12%) *Morellia* sp. The remaining taxa where 19 (2.37%) *Drosophila* sp., 16 (2.00%) sepsidae (8 *Sepsis* sp. and 8 undetermined), 5 (0.62%) heleomyzidae, 2 (0.25%) stratiomydae, 1 (0.12%) anophelidae, phoridae and sphaeroceridae.

3.2.2 Order coleoptera
The order coleoptera was hosting 15 (1.87%) divide into five groups with 10 (1.25%) histeridae (6 undetermined and 4 *Hister* sp.), 2 (0.25%) cleridae, 2 (0.25%) undetermined and 1 (0.12%) ptiliidae.
The orders lepidoptera and glomerida were respectively having 4 (0.50%) and 1 (0.12%) individual.

3.3 Succession of insects and other arthropod genus/species collected during the experiment
3.3.1 Fresh stage: Flies appeared some few hours after placement of the carcass inside the wooden research cage (Table 2). They have reign on the cadaver for two consecutive days corresponding to the first decaying stage with 332 (41.35%) individuals distributed to 22 (2.74%) insect for the first post-mortem day and 310 (38.61%) for the second day. During this decomposition phase, the first day was dominated by calliphoridae with 7 (0.87%) *Lucilia ampullacea*¸ 4 (0.50%) *L. caesar*, 3 (0.37%) *L. illustris*, *L. silvarum* and 2 (0.25%) *Chrysomya albiceps* followed by 3 (0.37%) muscidae. While the second day hosted predominantly calliphoridae with 172 (21.42%) *Lucillia illustris*, 33 (4.11%) *L. silvarum*, 28 (3.49%) *Hemipyrellia fernandica*, 8 (1.00%) *L. sericata* and 6 (0.75) *Tricyclea* sp. followed by 4 (0.50%) muscidae with 1 (0.12%) *Morellia* sp. and 3 (0.37%) *Sarcopromusca pruna*. The above flies were followed by 5 (0.62%) histeridae and 2 (0.25%) stratiomydae.

3.3.2 Bloated stage
The second decomposition stage of the carrion was invaded by 347 (43.21%) insects distributed in to 268 (33.37%) for the third post-mortem day and 79 (9.84%) during the fouth post-mortem day (Table 2). The major part of this necroentomofauna was calliphoridae with 190 (23.66%) and 37 (4.60%) namely *C. vanemdeni* [106 (13.30%) and 1 (0.12%)], *C. megacephala* [23 (2.86)], *L. sericata* [13 (1.62%) and 16 (1.99%)], *Hemipyrellia* sp. [(42 (5.23%)], *Phumosia* sp. [6 (0.75%) and 1 (0.12%)], *C. putoria* [19 (2.37%)] respectively. Then comes sarcophagidae glutting 44 (5.50%) which regroup *Sarcophaga* sp. [40 (4.98%)] and *Tricharaea* sp. [4 (0.50%)] at the third day and 22 (2.74%) which regroup *Tricharaea* sp. [22 (2.74%)] at the fouth day; 26 (3.24%) muscidae hosting *Atherigona* sp. [8 (1.00%] and *Hydrotaea* sp. [18 (2.24%)] at the third day and 20 (2.50%) which regroup *Hydrotaea* sp. [2 (0.25%)] and *Ophyra* sp. [18 (2.24%)] at the fouth day. The other invertebrates captured were 5 (0.62%) heleomyzidae, 1 (0.12%) cleridae, sepsidae and sphaeroceridae.

3.3.3 Decay stage
During the third state of corpse decomposition (day 5 to day 10), the fauna was characterized mainly by 17 (2.11%) calliphoridae [13 (1.62%) undetermined, 2 (0.25%) *C. putoria* and few *Chrysomya* sp. and *L. illustris* with only 1 (0.12%) individual] (Table 2). They were followed successively by 14 (1.74%) muscidae [3 (0.37%) *Hydrotaea* sp., 3 (0.37%) and 8 (1.00%) *Ophyra* sp.]; 12 (1.50%) sarcophagidae [10 (1.25%) *Sarcophaga africa* and 2 (0.25%) *sarcophaga* sp.]; 9 (1.12%) drosophilidae [9 (1.12%) *Drosophila* sp. and 4 (1.00%) histeridae [1 (0.12%) undetermined, 3 (0.37%) *Hister* sp.]. Some few invertebrates were also census: 1 (0.12%) culicidae (*Culex* sp.), 1 (0.12%) cleridae and glomeridae.

Table 1: Information on the richness/abundane/diversity of the overall fauna gathered during the study

Classes	Orders	Families	Genus/species	Number	%	Total number/families	%	Total number/orders	%	Total number/classes	%
Diplopoda	Glomerida	Undetermine		1	0,12	1	0,12	1	0,12	1	0,12
	Coleoptera		Undetermine	2	0,25	2	0,25				
		Cleridae	Undetermine	2	0,25	2	0,25				
		Histeridae		6	0,75						
			Hister sp.	4	0,50	10	1,25				
		Ptiliidae		1	0,12	1	0,12	15	1,87		
	Diptera	Anophelidae	*Anopheles* sp.	1	0,12	1	0,12				
		Calliphoridae	*Chrysomya albiceps*	2	0,25						
			Chrysomya megacephala	23	2,86						
			Chrysomya putoria	21	2,62						
			Chrysomya sp.	1	0,12						
			Chrysomya vanemdeni	107	13,33						
			Hemipyrellia fernandica	42	5,23						
Insecta			*Hemipyrellia* sp.	46	5,73						
			Lucilia caesar	4	0,50						
			Lucilia illustris	176	21,92						
			Lucilia sericata	37	4,61						
			Lucilia silvarum	36	4,48						
			Lucilia ampullacea	7	0,87						
			Phumosia sp.	7	0,87						
			Tricyclea sp.	6	0,75	515	64,13				
		Culicidae	*Culex* sp.	1	0,12	1	0,12				
		Drosophilidae	*Drosophila* sp.	19	2,37	19	2,37				
		Heleomyzidae		5	0,62	5	0,62				
		Muscidae	*Atherigona orientalis*	7	0,87						
			Atherigona sp.	9	1,12						
			Hydrotaea sp.	29	3,61						
			Morellia sp.	1	0,12						
			Sarcopromusca pruna	5	0,62						
			Ophyra sp.	30	3,74	81	10,09				
		Phoridae		1	0,12	1	0,12				
		Sarcophagidae	*Ravinia belforti*	2	0,25						
			Ravinia pernix	1	0,12						
			Sarcophaga africa	16	1,99						
			Sarcophaga sp.	44	5,48						
			Sarcophaga zumpti	2	0,25						
			Tricharaea (*Sarcophagula*) sp.	76	9,46	141	17,56				
		Sepsidae		8	1,00						
			Sepsis sp.	8	1,00	16	1,99				
		Sphaeroceridae		1	0,12	1	0,12				
		Stratiomyidae		2	0,25	2	0,25	783	97,51		
	Lepidoptera	Tineidae		4	0,50	4	0,50	4	0,50	802	99,88
Total				803	100	803	100	803	100	803	100
Genus/species richness/abundance				42		17		4		2	

The most important noticeable fact during the study, is the decreasing/disappearance of the dominant taxa of the two previous stages who are replaced by *Drosopila* sp. and *Hister* sp. colonizing the corpse for the first time. It seems like the first *Hister* sp. repulse their counterparts immediately when they colonize the carcass looking for their poor abundance 3 (0.37%).

3.3.4 Dried stage

Within this carrion alteration phase, some new species appears: sarcophagidae [1 (0.12%) *Ravinia pernix* and 2 (0.25%) *Sarcophaga zumpti*], muscidae [6 (0.75%) *Atherigona orientalis*] and sepsidae [8 (1.00%)] (Table 2). The decreasing/disappearance of diptera was drastically observed and being replaced by the coleopteran even though their number was low [2 (0.25%) undetermined and 1 (0.12%) ptiliidae].

3.3.5 Skeletonized stage

This last decomposition phase was almost dominated by coleopteran family ptiliidae and some diptera sarcophagidae [2 (0.25%) *Ravinia belforti*] (table 2) probably due to the sporadic rain that fell on the 18 January 2021. The lepidopterans family tineidae [3 (0.37%)] was also census for the first time since the beginning of the experiment.

Table 2: Information on the succession of insects and other arthropods on rat carrion within the experiment site

Days	Orders/Families	Genus/Species	Total number Genus/species	%	Total number/days	%
1	Calliphoridae	*Chrysomya albiceps*	2	0,25		
		Lucilia ampullacea	7	0,87		
		Lucilia caesar	4	0,50		
		Lucilia illustris	3	0,37		
		Lucilia silvarum	3	0,37		
	Muscidae	*Hydrotaea* sp.	3	0,37	22	2,74
2	Calliphoridae	*Hemipyrellia fernandica*	28	3,49		
		Lucilia illustris	172	21,42		
		Lucilia sericata	8	1,00		
		Lucilia silvarum	33	4,11		
		Tricyclea sp.	6	0,75		
	Histeridae		5	0,62		
	Muscidae	*Sarcopromusca pruna*	3	0,37		
		Morellia sp.	1	0,12		
	Sarcophagidae	*Sarcophaga africa*	2	0,25		
		Tricharaea (Sarcophagula) sp.	50	6,23		
	Stratiomyidae		2	0,25	310	38,61
3	Calliphoridae	*Chrysomya vanemdeni*	106	13,20		
		Lucilia sericata	13	1,62		
		Chrysomya megacephala	23	2,86		
		Phumosia sp.	6	0,75		
		Hemipyrellia sp.	42	5,23		
	Cleridae		1	0,12		
	Heleomyzidae		5	0,62		
	Muscidae	*Atherigona* sp.	8	1,00		
		Hydrotaea sp.	18	2,24		
	Sarcophagidae	*Tricharaea* sp.	4	0,50		
		Sarcophaga sp.	40	4,98		
	Sepsidae		1	0,12		
	Sphaeroceridae		1	0,12	268	33,37
4	Calliphoridae	*Chrysomya putoria*	19	2,37		
		Chrysomya vanemdeni	1	0,12		
		Lucilia sericata	16	1,99		
		Phumosia sp.	1	0,12		
	Muscidae	*Hydrotaea* sp.	2	0,25		
		Ophyra sp.	18	2,24		
	Sarcophagidae	*Tricharaea* sp.	22	2,74	79	9,84
5	Calliphoridae	*Chrysomya* sp.	1	0,12		
		Lucilia illustris	1	0,12		
	Cleridae		1	0,12		
	Culicidae	*Culex* sp.	1	0,12		
	Histeridae		1	0,12		
	Muscidae	*Hydrotaea* sp.	3	0,37		
	Sarcophagidae	*Sarcophaga africa*	10	1,25	18	2,24
6	Glomeridae		1	0,12		
	Histeridae	*Hister* sp.	2	0,25		
	Muscidae	*Ophyra* sp.	3	0,37	6	0,75
7	Histeridae	*Hister* sp.	1	0,12	1	0,12
8	Drosophilidae	*Drosophila* sp.	9	1,12		
	Sarcophagidae	*Sarcophaga* sp.	2	0,25	11	1,37

9	Calliphoridae		13	1,62		
	Muscidae	*Ophyra* sp.	8	1,00	21	2,62
10	Calliphoridae	*Chrysomya putoria*	2	0,25		
	Drosophilidae	*Drosophila* sp.	1	0,12	3	0,37
11	Calliphoridae	*Hemipyrellia* sp.	3	0,37		
	Drosophilidae	*Drosophila* sp.	9	1,12	12	1,49
12	Coleoptera		1	0,12		
	Muscidae	*Hydrotaea* sp.	1	0,12		
	Sarcophagidae	*Ravinia pernix*	1	0,12	3	0,37
13	Anophelidae	*Anopheles* sp.	1	0,12	1	0,12
14	Muscidae	*Hydrotaea* sp.	1	0,12		
	Sarcophagidae	*Sarcophaga zumpti*	1	0,12	2	0,25
15	Muscidae	*Atherigona* sp.	1	0,12		
	Sarcophagidae	*Sarcophaga* sp.	2	0,25	3	0,37
16	Coleoptera		1	0,12		
	Muscidae	*Atherigona orientalis*	1	0,12		
		Sarcopromusca pruna	1	0,12		
	Sarcophagidae	*Sarcophaga africa*	1	0,12	4	0,50
17	Sarcophagidae	*Sarcophaga zumpti*	1	0,12	1	0,12
18	Muscidae	*Atherigona orientalis*	5	0,62	5	0,62
19	Sepsidae		2	0,25	2	0,25
20	Sepsidae	*Sepsis* sp.	5	0,62	5	0,62
21	Phoridae		1	0,12		
	Tineidae		1	0,12		
	Sepsidae		2	0,25	4	0,50
22	Sepsidae		2	0,25	2	0,25
23	Sepsidae	*Sepsis* sp.	3	0,37	3	0,37
24	Ptiliidae		1	0,12		
	Sepsidae		1	0,12	2	0,25
25	Muscidae	*Atherigona orientalis*	1	0,12	1	0,12
26	Tineidae		1	0,12	1	0,12
27	Tineidae		1	0,12	1	0,12
28	Histeridae	*Hister* sp.	1	0,12	1	0,12
29	Muscidae	*Hydrotaea* sp.	1	0,12	1	0,12
30	Muscidae	*Sarcopromusca pruna*	1	0,12	1	0,12
31	Tineidae		1	0,12		
	Sarcophagidae	*Sarcophaga africa*	2	0,25	3	0,37
32	Sarcophagidae	*Sarcophaga africa*	1	0,12	1	0,12
33	Diptera		1	0,12	1	0,12
35	Calliphoridae	*Hemipyrellia* sp.	1	0,12		
	Sarcophagidae	*Ravinia belforti*	2	0,25	3	0,37
36	Muscidae	*Ophyra* sp.	1	0,12	1	0,12
Total			803	100	803	100

4. Discussion

4.1 Decaying process and sampling procedures

The study of the decaying process according to the morphological/physical modifications observed showed five distinct decomposition stages of the rat carrion which is similar to that of Goff (2009) [56], Al-Meshah *et al*. (2012) [57], Corrêa *et al*. (2014) [60], Silva *et al*. (2014) [59] and Azevedo *et al*. (2018) [58] emphasizing the influence of the parameters such as temperature, hygrometry, win speed, sunniness, rainfall etc. on the evolution of the decomposition of a cadaver. This key role played by these factors was also notice by Silahuddin *et al*. (2015) [23] and Dao *et al*. (2018a) [14] reinforcing that the abiotic factors such as climate and others factors intrinsic to the carcasses guided the decomposition process of the death animal. Authors like Dao *et al*. (2018b) [14] followed the decomposition process daily throughout the duration of the complete alteration of cadaver which is in accordance with our research protocol but differ from the methods practiced by Shaalan *et al*. (2017) [54] and Queiroz *et coll*. (2021) [24] who were inspected their carcasses twice daily for the for days 1-3 and daily to record decompositional status and to collect insects.

The sample of the necrophagous fauna was done concomitantly through three complementary methods (hand net capture, hand picking and pittfall traps) which is similar to the methods performed by Feugang Youmessi (2023), Feugang Youmessi and Djonga (2024) inside the campus of the University of Yaounde 1, Koffi *et al*. (2017) and Kpama-Yapo *et al*. (2021) [35] in the Guinean zone of Ivory Coast on Pigs' corpses (*Sus scrofa domesticus* L.). For both authors, the harvesting of necroentomofauna was done three times daily at 8:00 A. M., 12:00 P. M. and 16:00 P.M. although sampling hour of the authors differ from those of the researchers from Ivory Coast.

4.2 Richness of necroentomofauna

A total of 803 individuals associated with carrion were capture throughout all the field experiment. Their diversity analyzing yields two classes including 1 (0.12%) diplopoda and 802 (99.88%) insecta, four orders with 1 (0.12%) glomerida, 4 (0.50%) lepidoptera, 15 (1.87%) coleoptera and 783 (97.51%) diptera giving them as the most diverse

order following by coleoptera, lepidoptera and lastly glomerida. This finding is not in line with the results of Amendt *et al*. (2007) [44], Campobasso *et al.* (2001) [33] and Koffi *et al*. (2017) comforting the idea that necrophagous fauna vary depending on whether the corpse in exposed to the open air, or immerged, or buried. Regardless of the conditions under which a corpse is found (open air, buried or immerged), the composition of the insect involved in the decomposition of a cadaver and their "working time" may vary depending on the factors that influence the local necroentomofauna with/and the process of alteration of the death body; these include: the region and its geographic area, the type of locality (City/Urban or Countryside/Suburban), the type of location (inside or outside), the climate and weather (season), storage of the body and the volume of the corpse (Campobasso *et al*., 2001) [33].

The outcome of this research showed that the primary cadavers colonizing fauna were dipterans following by coleopterans, then comes the hymenopterans and others. Among the Diptera and in accordance with our observations in Yaounde, Dao *et al*. (2018a) [14], Kpama-Yapo *et al*. (2020) [34], Dawson *et al*. (2021) [51] and Naman *et al*. (2024) [21] also registered that the first arrival were individual belonging to the family Calliphoridae even though the colonization time was just some few hours in Yaounde contrary to 24 hours delay observed by the second authors during their experimentation on pig cadavers exposed to the open air in Sub-Sudanese zone in Ivory Coast. These results are consistent with patterns seen in other part of the world like those of Picimbon (2002) [18], Lee *et al*. (2004) [15], Dekeirsschieter (2007) [16], Silahuddin *et al*. (2015) [23] and Koffi *et al*. (2017). The early colonization of these flies could be the result of their highly developed olfactory organ witch enable them to smell and detect over long distance, very low odors not perceptible by humans nostrils (Dao *et al*., 2017; Yapo *et al*., 2017) [42, 14], Ebrahim and Nada (2021) [30] and El-Hawaguy (2018). Also, some authors like Kurahashi et Kirk-Springgs (2006) [13] highlighted that female Diptera require a protein meal for their egg maturation meaning that they are always in need of such nutrient for their offspring.

The secondary carrion invaders were coleopterans with 15 (1.87%) distributed to 6 (0.75%) histeridae, 4 (0.50%) *hister* sp., undetermined and cleridae with 2 (0.25%) each and 1 (0.12% ptiliidae. This occurrence position could also be conditioning by the presence of dipteran eggs and larvae since some of these beetle such as histeridae are eggs and larvae of diptera feeders. This agreement was reported after the work carried out by Campobasso *et al*. (2001) [33] in Italy on factors affecting their abundance on death body. Even though the membership of coleopteran as part of necrophagous fauna is in contrast with the output of Naman *et coll*. (2024) [21] at the Botanical garden of Kaduna State University, in Nigeria. This caveat can be explained by the experimental wet period used by these authors, sine it is one of the major factor affecting carcasses colonizers (Campobasso *et al*., op. cit.; Dao *et coll*., 2018a and 2018b) [33, 14].

4.3 Abundance and diversity of necroentomofauna

Diptera calliphoridae provided the largest number of species caught [515 (64.13%)], 42 taxa were identified with 31 genera and 16 species. This abundance followed the same trends as those obtained by others authors such as Biavati *et al*. (2010), Dieng *et al*. (2021) [31] and Cruickshand and Wall (2002) at Central Brazil, Feugang Youmessi *et al*. (2012 a and b) at Yaounde-Cameroon, Faria *et al*. (2013) [17] at Minas Gerais-Brazil, and Feugang Youmessi *et al*. (2021) at Yaounde-Cameroon.

The identification of all the specimens yields decreasingly *Lucilia illustris* [176 (21;92%)], *Chrysomya vanemdeni* [107 (13.33%)], *Tricharaea* (*Sarcophagula*) sp. [76 (9.46%)], *Hemipyrellia* sp. [46 (5.73%)], *Sarcophaga* sp. [44 (5.48%)], *Hemipyrellia fernandica* [42 (5.25%°], *Lucilia sricata* [37 (4.61%)], *Lucilia silvarum* [36 (4.48%)], *Ophyra* sp. [30 (3.74%)], *Hydrotaea* sp. [29 (3.61%)]. The similarity of this outcome with those of Dao *et al*. (2018b) [14] and Koffi *et al*. (2017) at Ivory Coast is understandable although the species aren't the same as there is a difference amongst regions; each one owns his abiotic characteristics affecting his inhabitant and also the endemism of certain species to a specific area.

Conclusion

This experimental setup delivered new information on entomofauna in related to their colonization behavior on carrion in the city of Yaounde, Cameroon, highlighting the importance to continue the inventory of necrophagous fauna in order to gain a better embezzlement of the judiciary insects in the Region. Some calliphoridae such as *Chrysomya megacephala*, *Chrysomya venemdeni*, *Lucilia Caesar*, *Lucilia illustris*, *Lucilia silvarum*, *Lucilia ampullacea*, *Phumosia* sp., *Tricyclea* sp., *Atherigona orientalis*, *Morellia* sp., *Sarcopromusca pruna*, *Ravinia belforti*, R. *pernix* and *Tricharaea* (*Sarcophagula*) sp. were identified for the first time as necroentomofauna within the study area. Further experiment is needed on forensic research for better understanding of the necrophagous insects and their use in solving crime.

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