



Evaluating Sampling Techniques for Soil Dwelling Arthropod Species Composition and Abundance in University of Uyo, Uyo, Akwa Ibom State, Nigeria

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Abstract

This study compared two sample approaches, pitfall traps and the Berlese-Tullgren extractor funnel, for the collection of soil-dwelling arthropod species at the University of Uyo between May and August 2023. For the study, three (3) sampling areas were selected: the Faculties of Science, Agriculture, and Engineering. The following physico-chemical parameters of the soil were measured: pH, temperature, dissolved oxygen, conductivity, chloride, nitrate, phosphate, sulphate, and nitrite. Pitfall traps made of plastic containers measuring 27cm deep with a mouth diameter of 30cm and containing 4 - 5% formalin were buried in 30cm deep dug soil. Berlese-Tullgren extractor funnels with 100watt bulbs were built from a 20L C-way plastic water container and screened with a 1mm mesh net. The results of the soil physico-chemical parameters revealed that the variables differed significantly between sampling sites at $p \leq 0.05$. Sixty-two (62) species of soil-dwelling arthropods were collected and classified into thirteen (13) orders and three classes, Insecta, Arachnida, and Diplopoda. The orders Orthoptera, Hemiptera, Coleoptera, Hymenoptera, and Lepidoptera comprise a large majority of the soil-dwelling arthropod species that were collected with pitfall traps. The order Diptera was unique to the Berlese-Tullgren extractor funnel, and diplopodans collected with the Berlese-Tullgren extractor sample technique were higher than those collected with the pitfall trap. A comparative analysis of the data on species diversity, individual and relative abundance, and soil-dwelling arthropod species revealed that the pitfall trap performed better than the Berlese-Tullgren extractor funnel in terms of collection efficiency. The likelihood of underrepresenting an order was eliminated since the pitfall trap sample approach, which is more efficient than the Berlese-Tullgren extractor funnel, complemented each other.

Key words: Berlese-Tullgren extractor funnel, Coleoptera, Hymenoptera, Orthoptera and Pitfall trap.

INTRODUCTION

Soil-dwelling arthropods play a crucial role in maintaining the functionality and sustainability of soil ecosystems (Bagyaraj *et al.*, 2016). Arthropod species that live in the soil also have a role in the cycling of nutrients by feeding on litter and converting nutrients into minerals. Additionally, they contribute to the creation of soil structures by mixing the soil, creating pores, and forming aggregates (Culliney, 2013). The soil, a component of the Earth's crust, serves as a crucial repository of biodiversity, encompassing both macro-

invertebrates and micro-invertebrates (Akpan *et al.*, 2021). Soil is a dynamic and complex ecosystem that is highly diverse and provides several ecological niches for arthropods and other animals (Menta, 2012; Akpabio *et al.*, 2015, Akpan *et al.*, 2021).

The composition, abundance, diversity, and richness of arthropod species that live in the soil are connected to the overall health of the soil ecosystem. This health is determined by the productivity and sustainability of the soil, which in turn depends on the changing physical, chemical, and biological properties of the soil. (Somasundaram *et al.*, 2013; Elias *et al.*, 2019; Bufebo and Elias, 2020, Akpan *et al.*, 2021). Nanganoa *et al.* (2019) found that the characteristics of soil ecosystems, including

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their physical, chemical, and biological aspects, are consistently impacted by the land use system.

The soil harbours a diverse array of arthropod species from various terrestrial ecosystems. The phylum Arthropoda exhibits the greatest species variety and richness, comprising up to 85% of the soil fauna (Culliney, 2013). The soil contains representatives of every subphylum of arthropods as well as every one of its terrestrial groups, including the following: Crustacea (woodlice and amphipods), Myriapoda (centipedes and millipedes), Hexapoda (true insects), and Cheliceromorpha (scorpions, pseudoscorpions, spiders, harvestmen, and mites). Gullan and Cranston (2005) and Ferrer-Paris *et al.* (2013) stated that the types of arthropods found in the soil vary on the specific sampling techniques adopted.

Studies have shown that pitfall traps and Berlese-Tullgren extractor funnels have been widely employed to study the composition of soil-dwelling arthropod species (Anu and Thomas, 2006; Anto and Thomas, 2007; Philpott *et al.*, 2007; Robertson, 2007; Vineesh *et al.* 2007).

Pitfall trap and Berlese Tullgren funnel techniques were employed for this work. Ewuim (1996, 1997, and 2007) and Ewuim and Nwuba (2002) suggested that the pitfall trap technique is the simplest, cheapest, and most successful technique among the sampling techniques for sampling active soil-dwelling arthropod species. Contrariwise Hansen and New (2005) and Leather and Watt (2005) stated that a pitfall trap is inefficient in trapping bottom dwellers. Berlese-Tullgren extractor funnels employ light to produce a thermal gradient on the soil core, and when the soil core sample dries out bottom soil-dwelling arthropods are driven downward and escape through the outlet and caught in a reservoir with or without preservative (Akpan *et al.*, 2021).

In this work, the efficiency of the two soil-dwelling arthropod sampling procedures was compared at the University of Uyo, Uyo, to determine if the two sample techniques are equally effective in the research of the composition, abundance, and diversity of soil-dwelling arthropod taxa.

MATERIALS AND METHODS

Study Area

The main campus of the University of Uyo was chosen as the research site for this study. Three (3) sampling sites were chosen at random: the

Faculties of Science, Agriculture, and Engineering (Figure 1). Faculty of Science is located between Latitude 5.0395647°N and Longitude 7.9818198°E. It is characterised by the presence of primarily trees, herbs, and shrubs. Faculty of Agriculture which lies between Latitude 5.0490367°N and Longitude 7.9772044°E, was designated as sample site 2. Vegetative coverings within the sampling site were thick. Sampling site 3; Faculty of Engineering, is between Latitude 5.0425779°N and Longitude 5.0425779°E. There were highly scarcely vegetative covers in this sampling site due to construction work and other activities. The topsoil at each sampling site is loamy, with farming operations conducted surrounding the sampling sites mostly planting cassava (*Manihot esculenta*) (Akpan *et al.*, 2021).

Soil Physico-chemical Parameters

The soil pH, temperature, electrical conductivity and dissolved oxygen (DO) were measured in situ with a pH meter (Model H18314 HANNA) and K120 digital duet electronic conduction meter (recorded soil temperature, conductivity, and DO). Soil samples were collected from the sampling sites using a hand towel for analysis of the following soil inorganic content: chloride, nitrate, sulphate, phosphate, and nitrite in the Department of Chemistry laboratory at the University of Uyo using standard protocols (Jamel, 2017). Nitrate, sulphate and phosphate are determined using the formula in equation 1 below

$$\frac{\text{Absorbance of Text} \times \text{Dilution Factory} \times \text{Concentration of Standard}}{\text{Absorbance of Standard} \times \text{Weight of Sample}} \dots\dots\dots(1)$$

$$\text{CI (mg/l)} = \frac{(\text{A-B}) \times \text{M} \times 70900}{\text{Volume (ml) of Sample}} \dots\dots\dots(2)$$

Soil Dwelling Arthropods Sampling

The sampling was carried out between May and August 2023, in the three (3) sampling sites: Faculty of Science, Faculty of Engineering, and Faculty of Agriculture. Each of the sampling sites was differentiated into four (4) micro-sites measuring out to 50m from each other.

Pitfall Trap Technique

A total of 12 pitfall traps made of plastic containers measuring 27cm deep with a mouth diameter of 30cm containing 4 - 5% formalin (Ewuim, 2007, Esenewo *et al.*, 2014) were buried in 30cm deep excavated soil with its rim flushing with the soil in all the sampling sites.

The sampling sites were divided from other regions with red ribbon lines to avoid encroachment. The traps at the different sampling sites were inspected after twelve hours of setting, and arthropods trapped were collected, stored in a plastic container, well labelled having the date of collection and sampling site, and taken to the laboratory of the Department of Animal and Environmental Biology, University of Uyo, for sorting and preserved in 10% formalin for later identification to genus level using morphological and pictorial keys provided by McGavin (2002) and Villet and Picker (2012), and counting using hand magnifying lens. The traps were left in place for four days (96 hours) before being removed.

Berlese-Tullgren extractor Funnel Technique

Four (4) Berlese-Tullgren extractor funnels were built using 20L C-way plastic water containers, screened with a 1 mm mesh net (Akpan *et al.*, 2021), set on an iron tripod stand with the opening end facing downward above conical flasks containing 70% alcohol, and equipped with 100-watt bulbs per funnel. The extractor funnel system was left in place for four (4) days before being disassembled. The soil samples utilised for the Berlese-Tullgren extractor funnel technique were collected from the three sampling sites at 0-10cm depth.

Data Analysis

The data obtained for this work were entered utilising Microsoft Excel (2016). Mean comparison and ANOVA for the physico-chemical parameters and inorganic contents were evaluated using SPSS version 20. Species diversity of the two sampling techniques was calculated using PAST 4.0.

RESULTS

Soil Physico-Chemical Parameters

The lowest soil pH concentration measured was observed in the Faculty of Agriculture, 5.00 ± 0.11 , whereas sample sites of the Faculty of Science had a pH value of 7.21 ± 0.11 and the Faculty of Engineering was 7.39 ± 1.97 . The results suggested that the pH difference was significant between the sampling sites at $p < 0.05$ (significant value = 0.306). The lowest value of DO (0.35 ± 0.03 mg/L) was measured for the Faculty of Engineering. DO (mg/L) (significant value = 0.02), conductivity (mg/l) (signif. value = 0.003), nitrate (mg/L) (signif. value = 0.707), sulphate (mg/L) (signif. value = 0.99), phosphate (mg/L) (signif. value =

(0.711), and nitrite (mg/L) (signif. value = 0.914) were significant between the sampling sites (Table 1).

Distribution Pattern of the Soil-Dwelling Arthropod Species

The distribution of the soil-dwelling arthropod species detected utilising the pitfall trap and the Berlese-Tullgren extractor funnel revealed that sixty-two (62) soil-dwelling arthropod species were collected. These were divided into three (3) classes (Insecta, Arachnida, and Diplopoda) and thirteen (13) orders. *Formica* sp was collected from both pitfall trap and Berlese-Tullgren extractor funnel sampling techniques. *Pachycondyla* sp was extracted from the soil sample using Berlese-Tullgren extractor funnel exclusively (Table 2).

Individual and Relative (%) Abundance of the Soil-dwelling Arthropod species

A total of 1437 individuals of the soil-dwelling arthropod species were collected with 1330 (92.55%) of the individuals of the arthropod species belonging to the class Insecta, 67 (4.67%) Arachnida, and 40 (2.78%) were Diplopoda. One thousand and twenty-four (1024 (71.26%)) specimens of the class Insecta were captured using pitfall traps. 32.71% (470) represented the order Hymenoptera out of which *Formica* sp (273) was the highest collected (Figure 2), followed by Orthoptera; 19.83% (285), Coleoptera 14.82% (213), 21.29% (306) of the individual arthropod species of the class, Insecta, were collected using Berlese-Tullgren extractor funnel with the taxa Coleoptera representing the highest with 8.35% (120) of the soil arthropod species, (Figure 3) followed by Hymenoptera 6.33% (91), and Orthoptera, 2.02% (29). From the overall results, 1102 (76.70%) of the individuals of the soil-living arthropod species were collected using the pitfall trap sampling technique, while 335 (23.30%) represented the soil-dwelling arthropod species collected using Berlese-Tullgren extractor funnel (Table 3). The comparative results of the individual abundance of the soil arthropod species collected using the pitfall trap and Berlese-Tullgren extractor funnel techniques indicate that *Formica* sp (273), *Pachycondyla* sp (12), and *Camponotus* sp (103) were collected using pitfall trap, while *Formica* sp (28), *Pachycondyla* sp (0), and *Camponotus* sp (42) were collected using Berlese-Tullgren extractor funnel (Figure 4).

The species diversity results as presented in

Table 4 revealed that with the pitfall trap sampling technique, the sampling areas; FoS (3.048), FoA (4.105), and FoE (3.607), recorded relatively high species diversity, while with the Berlese-Tullgren extractor funnel sampling technique, the sampling areas; FoS (2.792), FoA (2.141), and FoE (2.775), recorded relatively low species diversity.

The univariate correlation relationship results of the soil arthropod species collected with each of the soil physico-chemical parameters revealed that temperature, nitrate, and sulphate linked inversely with *C. vagus* ($r = -0.83$, $p \leq 0.05$) (Table 5). The correlation relationship status of soil-dwelling arthropod species with various soil physico-chemical parameters is also shown in the table.

DISCUSSION

The univariate correlation relationship results revealed that soil physico-chemical parameters such as temperature, nitrate, sulphate, phosphate, and nitrite had a strong inverse effect on the taxonomic richness, assemblage abundance, and distribution of the soil-dwelling arthropods collected using the two sampling techniques; pitfall trap and Berlese-Tullgren extractor funnel. The soil at the Faculty of Science is alkaline, which, together with the recorded levels of DO and other physico-chemical characteristics and inorganic contents, favoured the taxonomic and individual richness of this site over other sample locations on the main campus of the University of Uyo (Akpan *et al.*, 2020). Bufebo and Elias (2020) and Akpan *et al.* (2021) reported that the taxonomic richness and individual composition, abundance, and diversity of soil dwelling arthropods are linked to soil health, which is determined by its physico-chemical properties.

The capture of important soil-dwelling arthropod taxa differed across the two studied sampling techniques. The pitfall trap collected the most soil active order (both individual and relative), while the Berlese-Tullgren extractor funnel collected the least (23.30%). This percentage difference proved that the pitfall trap was a more efficient method of sampling soil-dwelling arthropods than the Berlese-Tullgren extractor funnel (Sabu and Shiju, 2010). Regardless of the effectiveness of the pitfall trap sampling technique, few individuals of the soil-dwelling arthropod orders Diptera and Spirostreptida that were not captured with

the pitfall traps were captured with the Berlese-Tullgren extractor funnel, which could be attributed to the low abundance and frequency of occurrence, as well as the less activeness of individuals of these orders at the University of Uyo (Vineesh, 2007; Anu *et al.*, 2009). The recording of low taxonomic groups, assemblage composition and abundance, and frequency of occurrence of soil-dwelling arthropods with the Berlese-Tullgren extractor funnel may also be attributed to the fact that most of the soil-dwelling arthropods sampled in this study are unable to burrow through the 0-10cm depth of soil from which soil samples were collected for arthropod extraction.

Pitfall trap capturing of soil-dwelling arthropods is evident in the taxonomic richness and assemblage composition and abundance of individuals of taxa that were active and fast-moving at the top soil; Hymenoptera, Coleoptera, Hemiptera, Orthoptera, Arachnida, Blattodea, and Lepidoptera (Prasifka *et al.*, 2007; Sabu and Shiju, 2010), and may be attributed to the vegetative composition of the University of Uyo ecosystem (Corti *et al.*, 2013). According to the abundance and diversity data, pitfall traps collected more individuals and species diversity than Berlese-Tullgren extractor funnels, although the evenness of the soil-dwelling arthropod species was lower. This was consistent with the findings of Nsengimana *et al.* (2017), who discovered that Berlese-Tullgren extractor funnels captured fewer soil-dwelling arthropod species. The Berlese-Tullgren extractor funnels technique, on the other hand, collected relatively low species diversity but good evenness of species distribution across sampling sites. The low number of individuals recovered with the Berlese-Tullgren extractor funnel could also potentially be attributable to the effect of heat from the apparatus's bulb (Bestmeyer *et al.*, 2000). Some of the soil-dwelling arthropod species may have died owing to dehydration in the sand core before travelling through the heat gradient formed on the sand and did not fall into the collection jar (Sabu *et al.*, 2012).

According to Southwood and Henderson (2000) and Brown and Matthews (2016), the efficiency of the pitfall traps sampling technique over the Berlese-Tullgren extractor funnel sampling technique in this study could be attributed to the location of the trap, the size of the trap container, the nature of the container,

the timing of trapped sample collection, the type of liquid preservative used, and the soil physico-chemical parameters. The Berlese-Tullgren extractor funnel technique was less effective in collecting soil dwelling arthropod species at the University of Uyo. The composition, individual, and relative abundance differences seen in this study suggest that no one sampling technique is optimal for sampling all orders of soil-dwelling arthropods and that more than two techniques may be required (Standen, 2000; Sabu and Shiju, 2010).

CONCLUSION

The pitfall trap technique was shown to be

better suitable for sampling soil dwelling arthropod species in this study. According to the diversity results, the pitfall trap performed better than the Berlese-Tullgren extractor funnel sampling technique in sampling soil-dwelling arthropod species. Nonetheless, when focused on qualitative and quantitative taxa of ecological value, the combination of the two sampling techniques is highly recommended for sampling of soil-dwelling arthropod species.

Table 1: Mean (\pm SE) of the soil physico-chemical parameters in University of Uyo

	pH	Temperature (°C)	DO (mg/L)	Conductivity (mg/L)	Chloride (mg/L)	Nitrate (mg/L)	Sulphate (mg/L)	Phosphate (mg/L)	Nitrite (mg/L)
FoS	---	27.08 \pm 0.30	0.60 \pm 0.07	95.20 \pm 5.61	6.65 \pm 0.34	3.07 \pm 0.07	7.48 \pm 0.39	2.14 \pm 0.06	0.71 \pm 0.08
FoA	5.00 \pm 0.11	30.48 \pm 0.28	0.60 \pm 0.07	58.50 \pm 4.57	6.70 \pm 0.34	3.22 \pm 0.19	7.52 \pm 0.39	2.19 \pm 0.07	0.68 \pm 0.05
FoE	7.39 \pm 1.97	28.35 \pm 0.40	0.35 \pm 0.03	50.50 \pm 9.29	6.70 \pm 0.34	3.13 \pm 0.07	7.56 \pm 0.40	2.22 \pm 0.07	0.68 \pm 0.06
Total	6.53 \pm 0.68	28.63 \pm 0.46	0.52 \pm 0.05	68.07 \pm 6.86	6.68 \pm 0.18	3.14 \pm 0.07	7.52 \pm 0.21	2.18 \pm 0.04	0.69 \pm 0.03
pvalue	0.306*	0.00	0.024*	0.003*	0.994*	0.707*	0.99*	0.711*	0.914*

* = significant Mean significant tested of each of the parameter was at $p \leq 0.05$

Note: FoS: Faculty of Science, FoA: Faculty of Agriculture, FoE: Faculty of Engineering

Table 2: Composition of the soil dwelling arthropod species in University of Uyo using the pitfall trap (PFT) and Berlese Tullgren extractor funnel (BTEXF)

S/N	Phylum	Class	Order	Scientific name	PFT	BTEXF
1				<i>Formica sp</i>	+	+
2				<i>Pachycondyla sp</i>	+	-
3				<i>Camponotus vagus</i>	+	+
4				<i>C. africeps</i>	+	-
5				<i>C. abdominalis</i>	+	-
6			Hymenoptera	<i>C. herculeanus</i>	+	-
7				<i>Camponotus japonicus</i>	-	+
8				<i>Lasuis sp</i>	-	+
9				<i>Odontomachus sp</i>	+	-
10				<i>Apis sp</i>	+	-
11				<i>Paraponera sp</i>	+	-
12				<i>Monomorium sp</i>	+	-
13				<i>Harpegnathos sp</i>	-	+
14			Coleoptera	<i>Sitophilus sp</i>	-	+
15	Arthropoda			<i>Platynus sp</i>	+	-
16				<i>Harpalus sp</i>	+	-
17		Insecta		<i>Calathus sp</i>	+	-
18				<i>Blatica dubia</i>	+	-
19				<i>Leistus sp</i>	+	-
20				<i>Anomala sp</i>	+	-
21				<i>Tenebrio sp</i>	+	+
22				<i>Dynastinae sp</i>	+	-

23			<i>Lochmaea sp</i>	+	-
24			<i>Listronotus bonariensis</i>	+	-
25			<i>Zophobas sp</i>	+	-
26			<i>Trogoderma sp</i>	+	-
27			<i>Pyrophorus sp</i>	+	+
28			<i>Dysticus sp</i>	+	+
29			<i>Pheropsophus sp</i>	+	-
30			<i>Deltochilum sp</i>	+	-
31			<i>Tenebrio sp</i>	+	-
32			<i>Calosoma sp</i>	+	-
33			<i>Titanus sp</i>	+	-
34			<i>Alphitobius sp</i>	+	-
35		Diptera	<i>Cuterebra sp</i>	-	+
36		Orthoptera	<i>Teleogryllus sp</i>	+	-
37			<i>Velarifictous sp</i>	+	-
38			<i>Gryllus bimaculatus</i>	+	-
39			<i>Acheta domesticus</i>	+	-
40			<i>Grylliodes sp</i>	+	-
41			<i>Califera sp</i>	+	-
42		Hemiptera	<i>Rhyparochromidae sp</i>	+	-
43			<i>Reduvis personatus</i>	+	-
44			<i>Halymorpha halys</i>	+	-
45			<i>Acanthaspis sp</i>	+	-
46			<i>Triatoma sp</i>	-	+
47		Lepidoptera	<i>Chrysopoloma sp</i>	+	-
48			<i>Ascalapha odorata</i>	+	-
49		Blattoidea	<i>Parcoblatha sp</i>	+	+
50		Dermaptera	<i>Forficula sp</i>	+	-
51		Zygentoma	<i>Lepisma sp</i>	+	+
52	Arachnida	Araneae	<i>Lucosidae sp</i>	+	+
53			<i>Ctenizidae sp</i>	+	+
54			<i>Araneus sp</i>	+	-
55			<i>Badumna sp</i>	+	-
56			<i>Erastigena sp</i>	+	-
57			<i>Sicariidae sp</i>	+	-
58			<i>Sparassidae sp</i>	+	-
59	Diplopoda	Opisthopora	<i>Lumbricina sp</i>	+	+
60		Spirostreptida	<i>Archispirostreptus gigas</i>	+	-
61			<i>Spirostreptus sp</i>	+	-
62		Pachybolida	<i>Pachybolus sp</i>	+	-

Note: +: presence, -: Not presence.

Table 3: The individual and relative (%) abundances of the taxa of the soil dwelling arthropod species collected in University of Uyo.

S/N	CLASS	ORDER	PFT (%)	BTEF (%)
1		Hymenoptera	470(32.71)	91(6.33)
2		Coleoptera	213(14.82)	120(8.35)
3		Orthoptera	285(19.83)	29(2.02)
4	Insecta	Hemiptera	17(1.18)	26(1.80)
5		Lepidoptera	10(0.70)	-
6		Diptera	-	1(0.07)
7		Blattoidea	6(0.42)	4(0.28)
8		Dermaptera	19(1.32)	24(1.67)
9		Zygentoma	4(0.28)	11(0.77)
		Total	1024(71.26)	306(21.29)
10	Arachnida	Araneae	59(4.11)	8(0.56)
		Total	59(4.11)	8(0.56)
11	Diplopoda	Opisthopora	9(0.63)	5(0.35)
12		Spirostreptida	2(0.14)	3(0.20)
13		Pachybolida	8(0.56)	13(0.90)
		Total	19(1.33)	21(1.45)
			1102(76.70)	335(23.30)
		GRAND TOTAL	1437	

Note: PFT: Pitfall Trap, BTEF: Berlese Tullgren Extractor funnel.

Table 4: Species diversity results of the pitfall trap and Berlese Tullgren extractor funnel Techniques used during the sampling period.

PARAMETERS	PITFALL TRAP			BERLESE-TULLGREN EXTRACTOR FUNNEL		
	FoS	FoA	FoE	FoS	FoA	FoE
Taxa_S	37	24	20	22	11	17
Individuals	626	316	160	117	98	107
Dominance_D	0.237	0.089	0.138	0.088	0.140	0.067
Simpson_1-D	0.763	0.911	0.862	0.911	0.860	0.933
ShannonH_log2	3.048	4.105	3.607	2.792	2.141	2.775
Evenness_e^H/S	0.223	0.717	0.609	0.742	0.774	0.943
Margalef	5.591	3.996	3.744	4.41	2.18	3.424
Fisher_alpha	8.603	6.034	6.033	8.005	3.179	0.140

Note: FoS: Faculty of Science; FoA: Faculty of Agriculture; FoE: Faculty of Engineering

Table 5: Univariate correlation analysis results of the soil dwelling arthropod species with the soil physico-chemical parameters.

	pH	Temperature	DO	Conductivity	Chloride	Nitrate	sulphate	Phosphate	Nitrite
<i>Formica sp</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Pachycondyla sp</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Camponotus vagus</i>	0.51	-0.83	0.43	0.43	0.97	-0.83	-0.83	-0.89	1.00
<i>C. africeps</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>C. abdominalis</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>C. herculeanus</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Odontomachus sp</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Apis sp</i>	0.56	-0.14	-1.00	-1.00	-0.64	-0.15	0.86	0.79	-0.38
<i>Paraponera sp</i>	0.93	-0.68	-0.82	-0.82	-0.09	-0.68	0.41	0.31	0.21
<i>Monomorium sp</i>	0.74	-0.38	-0.97	-0.97	-0.43	-0.38	0.71	0.62	-0.15
<i>Platynus sp</i>	-0.83	0.50	0.93	0.93	0.31	0.50	-0.60	-0.51	0.01
<i>Harpalus rufipes</i>	-0.42	-0.01	0.99	0.99	0.75	-0.01	-0.93	-0.88	0.52
<i>Calathus sp</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Blatica dubia</i>	0.64	-0.24	-0.99	-0.99	-0.56	-0.24	0.80	0.73	-0.29
<i>Leistus sp</i>	-0.97	0.78	0.73	0.73	-0.06	0.78	-0.27	-0.17	-0.35
<i>Anomala cuprea</i>	1.00	-0.93	-0.50	-0.50	0.35	-0.93	-0.02	-0.13	0.61
<i>Tenebrio molitor</i>	-0.91	0.65	0.85	0.85	0.13	0.65	-0.45	-0.35	-0.17
<i>Dynastinae sp</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Lochmaea sp</i>	0.65	-0.26	-0.99	-0.99	-0.55	-0.26	0.79	0.72	-0.27
<i>Listronotus bonariensis</i>	0.70	-0.33	-0.98	-0.98	-0.48	-0.33	0.74	0.66	-0.20
<i>Zophobas morio</i>	0.65	-0.26	-0.99	-0.99	-0.55	-0.26	0.79	0.72	-0.27
<i>Trogoderma granarium</i>	0.80	-0.46	-0.94	-0.94	-0.35	-0.46	0.64	0.55	-0.06
<i>Pyrophorus sp</i>	0.65	-0.26	-0.99	-0.99	-0.55	-0.26	0.79	0.72	-0.27
<i>Dysticus marginalis</i>	-1.00	0.88	0.60	0.60	-0.24	0.88	-0.10	0.01	-0.52
<i>Pheropsophus jessoensis</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Deltochilum sp</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Tenebrio obscurus</i>	-0.95	0.99	0.28	0.28	-0.56	0.99	0.26	0.36	-0.78
<i>Calosoma scrutator</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Titanus giganteus</i>	-1.00	0.89	0.58	0.58	-0.26	0.89	-0.07	0.04	-0.54
<i>Alphitobius sp</i>	-1.00	0.89	0.58	0.58	-0.26	0.89	-0.07	0.04	-0.54
<i>Teleogryllus sp</i>	-0.25	-0.20	0.94	0.94	0.86	-0.20	-0.98	-0.95	0.67
<i>Gryllus bimaculatus</i>	0.50	-0.82	0.44	0.44	0.97	-0.82	-0.84	-0.90	1.00
<i>Acheta domesticus</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Grylliodes sigillatus</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Califera sp</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Rhyparochromidae sp</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Reduvis personatus</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Halymorpha halys</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Acanthaspis sp</i>	0.56	-0.14	-1.00	-1.00	-0.64	-0.15	0.86	0.79	-0.38
<i>Chrysopoloma sp</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Ascalapha odorata</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Parcoblatha sp</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Forficula sp</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Lepisma sp</i>	0.56	-0.14	-1.00	-1.00	-0.64	-0.15	0.86	0.79	-0.38
<i>Lucosidae sp</i>	-0.66	0.27	0.99	0.99	0.53	0.27	-0.78	-0.71	0.26
<i>Ctenizidae sp</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Araneus sp</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Badumna insignis</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Erastigena agrestis</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Sicariidae sp</i>	0.90	-0.62	-0.87	-0.87	-0.17	-0.62	0.48	0.38	0.13
<i>Sparassidae sp</i>	0.44	-0.79	0.50	0.50	0.99	-0.78	-0.88	-0.92	0.99
<i>Lumbricina sp</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Archispirostreptus gigas</i>	-1.00	0.93	0.50	0.50	-0.35	0.93	0.02	0.13	-0.61
<i>Pachybolus sp</i>	-0.76	0.97	-0.11	-0.11	-0.84	0.97	0.61	0.69	-0.96

Note: the significant of the correlation results are marked by the – and + signs.

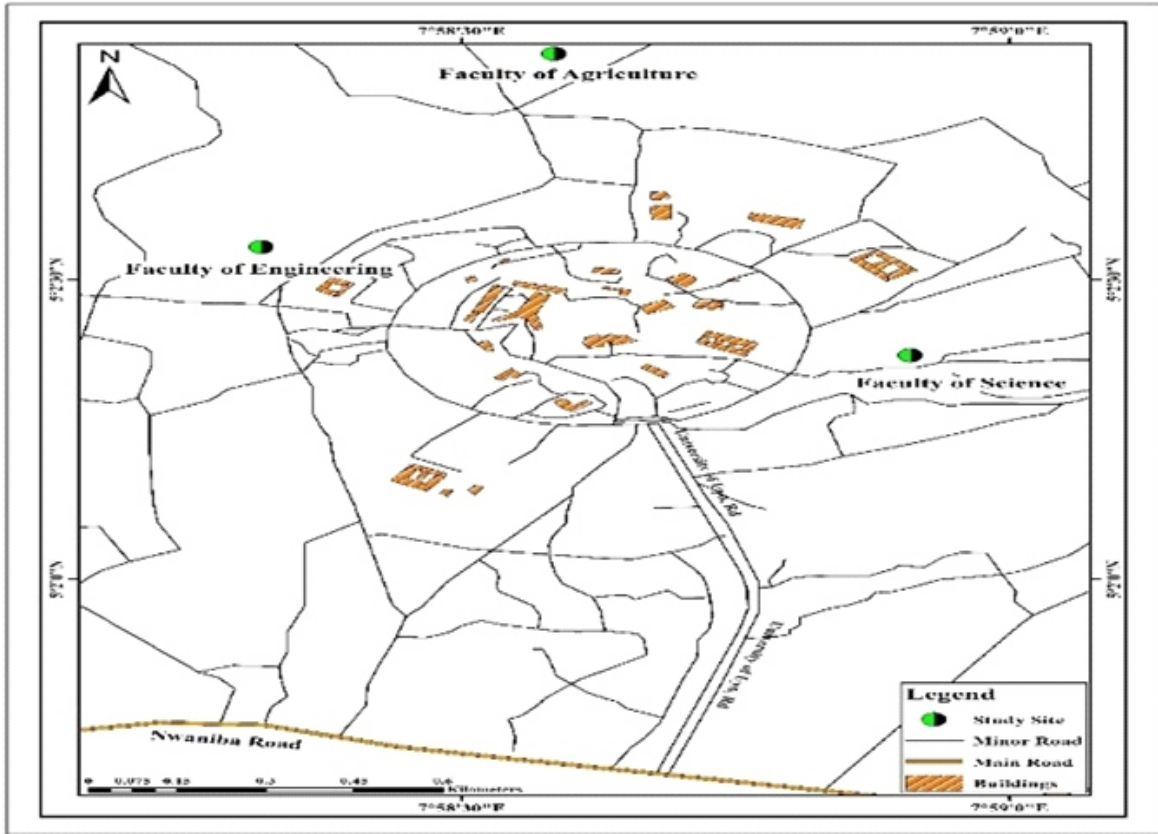
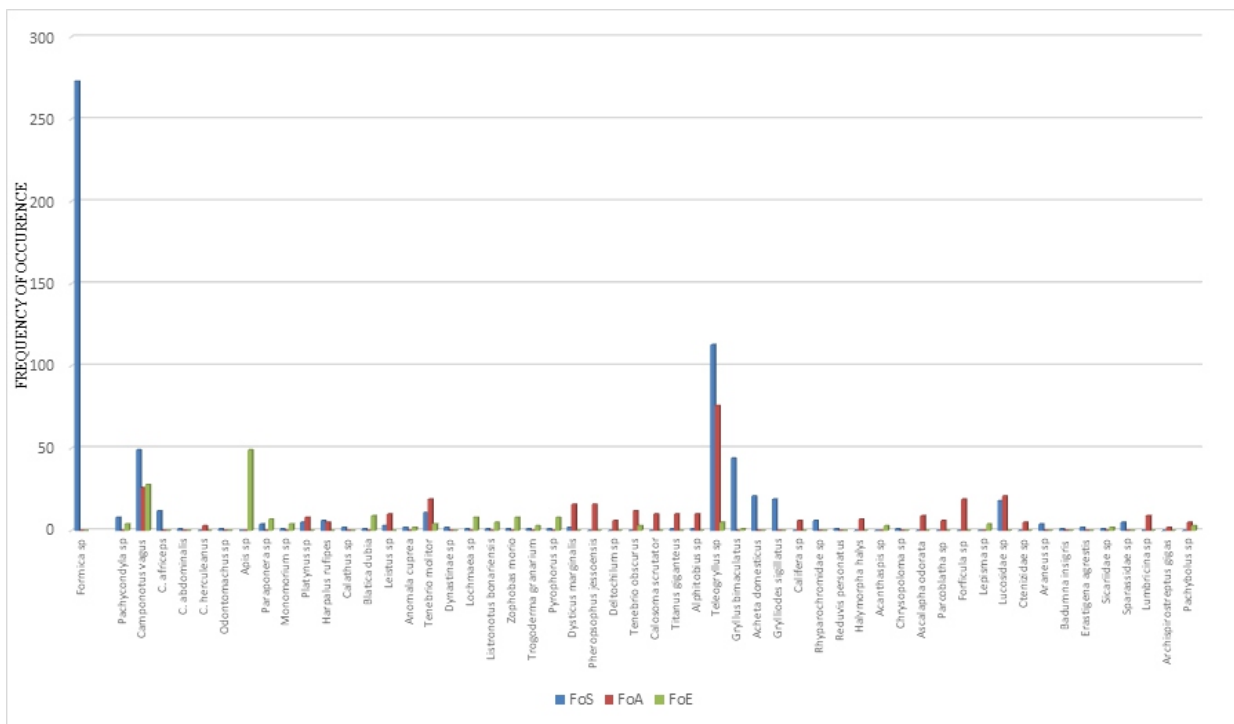
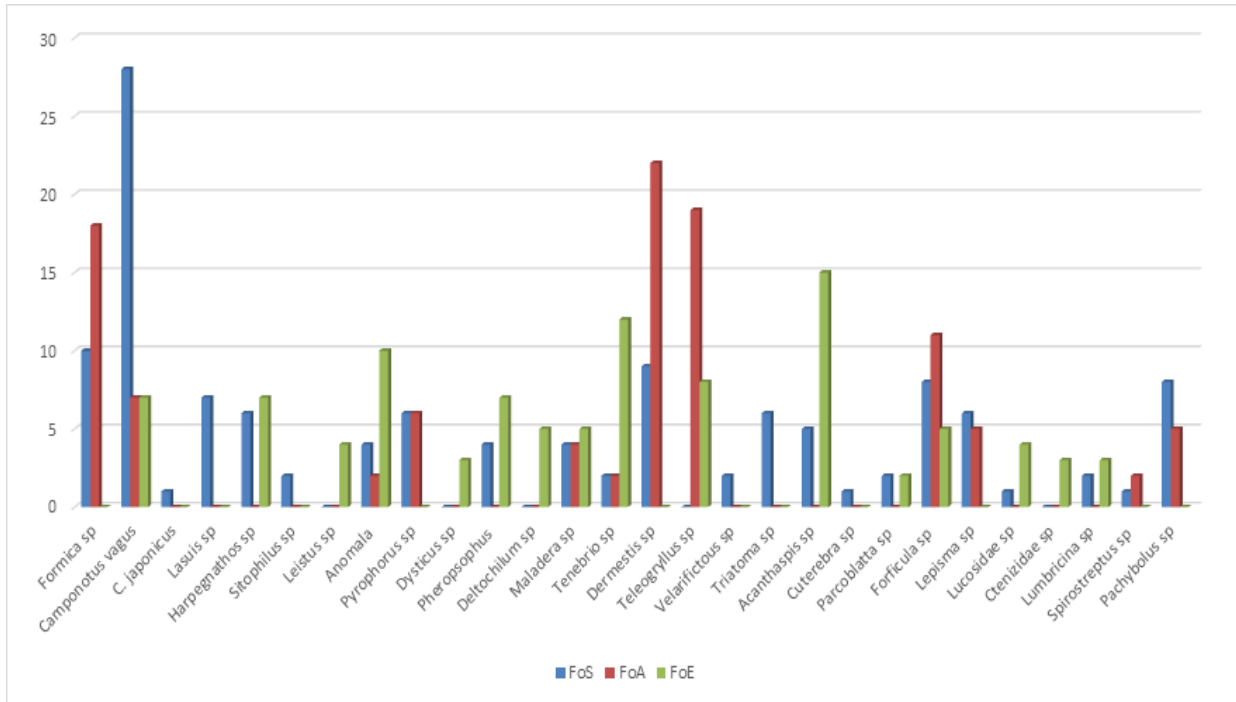


Figure 1: Maps showing the sampling sites in the University of Uyo main campus, Uyo. Akwa Ibom State. (Source: Cartography studio, Department of Geography and Natural Resources Management, University of Uyo. Uyo.)

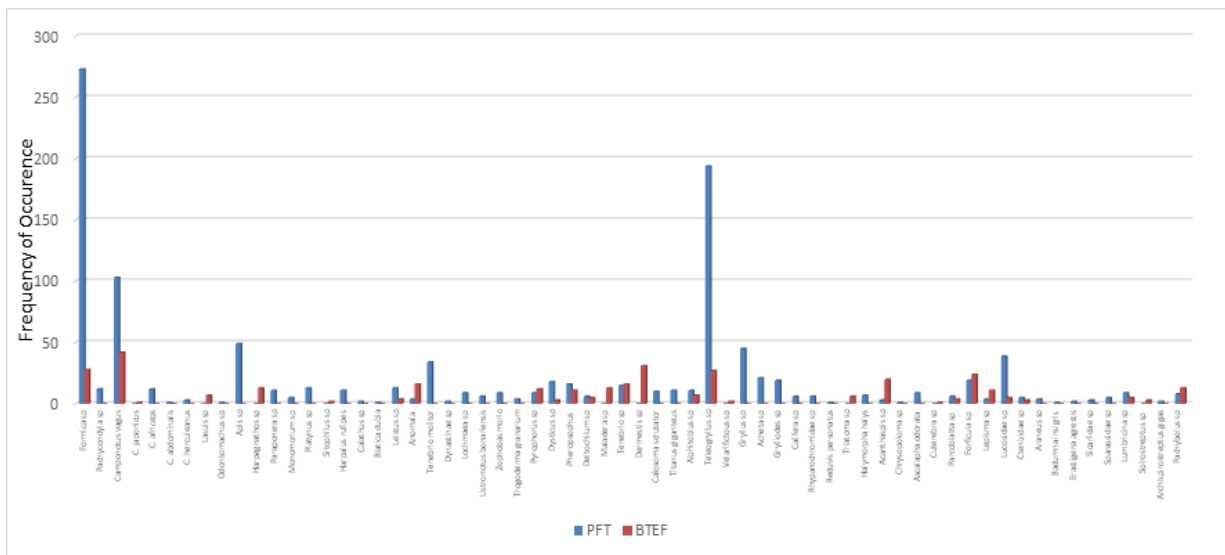


Note: FoS: Faculty of science, FoA: Faculty of Agriculture, FoE: Faculty of Engineering

Figure 2: Column graph showing frequency of occurrence of the soil dwelling arthropod species from the pitfall trap during the study period.



NOTE: FoS: Faculty of science, FoA: Faculty of Agriculture, FoE: Faculty of Engineering
 Figure 3: Column graph for the soil dwelling arthropod species frequency of occurrence from the sampling sites using Berlese-Tullgren extractor funnel).



NOTE: PFT: Pitfall Trap; BTEF: Berlese-Tullgren Extractor Funnel

Figure 4: Comparing the soil dwelling arthropod species frequency of occurrence from the two sampling methods during the study period.

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