Efficiency of Pitfall Traps and Sweep Nets in Collecting Insects in Soils Contaminated WithPalm Oil and Spent Engine Oil Effluents in Abakiliki, Ebonyi State

ABSTRACT

This study investigates the ecological consequences of palm oil and spent engine oil effluents on insect populations, employing a comparative analysis of two widely used collection techniques: pitfall traps and sweep netting. The aim is to assess the effectiveness of these methods in capturing and quantifying insect diversity and abundance in contaminated environments. The research was conducted in selected sites exposed to palm oil and spent engine oil effluents, with corresponding control sites for comparison.Pitfall traps and sweep netting were deployed simultaneously to collect insects across various habitats impacted by the aforementioned effluents. The collected specimens were then identified to the lowest taxonomic level possible, and population data were analyzed to evaluate the relative impact of each effluent type on insect communities. Furthermore, statistical analyses were employed to compare the efficiency and sensitivity of pitfall traps and sweep netting in detecting changes in insect populations under these environmental stressors. Findings suggest significant alterations in insect diversity and abundance in areas affected by palm oil and spent engine oil effluents. Moreover, the comparative analysis of collection techniques indicates variations in their ability to capture different insect taxa. This study contributes to the ecological repercussions of industrial effluents on insect populations, offering a methodological comparison that can enhance the precision of future insect-related environmental assessments.

Keywords: Palm oil, spent engine oil, effluents, insect, pit fall traps and sweep netting.

1. Introduction

The impact of palm oil and spent engine oil effluents on insect populations is a critical aspect of environmental health that warrants focused attention. As key components of terrestrial ecosystems, insects play pivotal roles in various ecological processes, including pollination, decomposition, and nutrient cycling (Odebode*et al*., 2021). The widespread use and disposal of palm oil and spent engine oil in industrial processes have raised concerns about their potential ecological consequences, particularly on insect communities.

Palm oil, a ubiquitous ingredient in food and cosmetic products, is associated with large-scale deforestation and habitat destruction. The expansion of palm oil plantations often leads to the displacement of native flora and fauna, disrupting the intricate balance of ecosystems (Omojola*et al*., 2020). Additionally, the runoff from palm oil processing facilities introduces a range of chemical compounds into nearby water bodies, further exacerbating environmental concerns (Ubani*et al*., 2017).Similarly, spent engine oil, a byproduct of the automotive industry, poses a significant threat to the environment. Improper disposal or leakage can contaminate soil and water, introducing toxic substances that are harmful to both aquatic and terrestrial organisms (Peter, 2023; Ogwu*et al*., 2021). Insects, being highly sensitive to environmental changes, serve as valuable indicators of ecological disturbances. Shifts in their abundance, diversity, and behavior can signal broader environmental imbalances.

Pitfall traps and sweep netting are two widely employed collection techniques in ecological studies, particularly in entomology, offering complementary knowledge into insect populations and their habitats. Pitfall traps consist of containers buried in the ground, creating a pit that insects inadvertently fall into (Spaffordand Lortie, 2013). These traps are effective for ground-dwelling arthropods, providing a non-invasive means to capture and study them. Pitfall traps are especially useful for sampling species that may not be easily observed through direct observation.On the other hand, sweep netting involves sweeping a net through vegetation, capturing insects in flight or resting on plants (Hohbeinand Conway, 2018). This technique is versatile and suitable for sampling a broad range of insects, including those inhabiting diverse microhabitats. Sweep netting allows researchers to collect specimens from various heights and vegetation types, providing a more comprehensive understanding of insect communities (Berglundand Milberg, 2019).

Both techniques contribute significantly to ecological research, enabling scientists to assess insect abundance, diversity, and community composition. The choice between pitfall traps and sweep netting depends on the specific objectives of the study and the target insect groups, with researchers often employing a combination of these methods for a more holistic evaluation of insect populations in a given ecosystem (ShwetaandRajmohana, 2018).The impact on insect populations is multifaceted. Exposure to pollutants from palm oil and spent engine oil can directly harm insects through toxicity, affecting their physiology and life cycles. Furthermore, these pollutants can alter the composition of plant communities, disrupting the availability of resources for insects (ShwetaandRajmohana, 2016). Changes in vegetation can have cascading effects on insect herbivores, pollinators, and predators, ultimately influencing the structure and function of ecosystems.

The study stems from a growing concern about the environmental consequences of industrial activities. Palm oil production and the disposal of spent engine oil are two major contributors to environmental pollution (Mahlia*et al*., 2019; Agathokleous*et al*., 2023), and their impact on insect populations, crucial components of ecosystems, remains inadequately explored. The motivation for this study is rooted in the urgent need to bridge existing gaps in our understanding of how these pollutants affect insect communities, and the comparative use of pitfall traps and sweep netting adds a nuanced dimension to this investigation.

Palm oil, a versatile vegetable oil, has witnessed a surge in demand globally, leading to expansive plantations and increased discharge of effluents into surrounding ecosystems. The environmental repercussions of palm oil cultivation are profound, affecting soil, water, and air quality (Lee*et al*., 2014). However, despite its widespread use, the impact of palm oil effluents on insect populations has not been comprehensively elucidated. The study aims to fill this gap by providing empirical evidence on how palm oil effluents influence the abundance, diversity, and community structure of insects.In a parallel context, the improper disposal of spent engine oil poses a significant threat to ecosystems (Oriomah*et al*., 2015; Ukachukwu*et al*., 2023). The toxic components of engine oil can persist in the environment for extended periods, causing long-term damage. Although the impact of oil spills on aquatic ecosystems has been extensively studied, the effects on terrestrial insect populations, particularly in conjunction with palm oil effluents, remain underexplored. The study seeks to contribute to this understudied area and shed light on the potential synergistic or antagonistic effects of these pollutants on insect communities.

To illustrate the existing gaps in literature, consider the work of Meijaard*et al*. (2020), which focused on the ecological impact of palm oil cultivation but primarily emphasized effects on vertebrate fauna. While the study highlighted the broader environmental consequences, it lacked a detailed examination of how insects, integral to ecosystem dynamics, respond to palm oil effluents. Similarly, studies on spent engine oil pollution often concentrate on the immediate vicinity of spill sites, neglecting potential long-range impacts on terrestrial ecosystems (Obini*et al*., 2013).Moreover, existing methodologies for studying insect populations often lean toward a single approach, such as pitfall trapping or sweep netting, without direct comparisons. This presents a limitation in our understanding, as different techniques may capture distinct facets of insect diversity. A comprehensive approach that incorporates both pitfall traps and sweep netting allows for a more holistic evaluation of insect responses to environmental stressors.

The choice of collection techniques, pitfall traps and sweep netting, adds a critical layer to the study's motivation. Pitfall traps, being ground-based, are well-suited for capturing soil-dwelling arthropods, providing valuable awareness into insects with limited mobility (GardarinandValantin-Morison, 2021; Jiménez-Carmona*et al*., 2019). Sweep netting, on the other hand, captures flying or perching insects within vegetation, offering a broader perspective on insect communities (Spaffordand Lortie, 2013). By comparing these methods, the study aims to discern potential biases in sampling and provide a more nuanced understanding of insect responses to pollutant exposure. The study aspires to contribute to the broader field of environmental science by offering empirical awareness into the intricate relationships between anthropogenic pollutants and insect populations, crucial for maintaining ecological balance.

2. Methods

2.1 Research Site Description:

The study was conducted at Ebonyi State University's Presco Campus in the Abakaliki capital territory of Ebonyi State, Southeast Nigeria. The campus is situated in the Guinea Savannah zone at approximately 8° 0798°E latitude and 6° 327 N longitude. The climate is characterized by two distinct precipitation phases in June and September, with an annual rainfall ranging from 1000 mm to 1500 mm. The mean annual temperature ranges between 29°C and 30°C, while relative humidity varies from 60% to 80%, decreasing in the early dry season. The terrain comprises undulating plains with irregular river valleys and steep ridges, featuring a dendritic drainage pattern. The open savannah woodland environment is rich in biodiversity, hosting woody trees, shrubs, herbs, palms, climbers, and tall grasses, with occasional forest formations in low-lying regions and along riverbanks.

2.2 Habitat Zones and Data Collection Methods:

The research site was divided into two distinct habitat zones. Quantitative assessment methods, specifically handheld sweep nets and pitfall traps, were employed to evaluate insect populations following the methodology outlined by Belamkar and Jadesh (2014).

2.3 Method of Data Collection

2.3.1. Monitoring (Line Transect): Line transects of 0.23 kilometers were established at each site, mirroring the approach used by Yager *et al*. (2016). Six transect walks, lasting 30 minutes each, were conducted in the two habitats.

2.3.2. Sweep Net: Utilizing handheld sweep nets, insect sampling occurred twice a week in the morning and evening along predetermined transect routes, targeting ground-level vegetation.

2.3.3. Pitfall Traps: Twelve traps, four in each habitat, were deployed. Each pitfall trap, following specific dimensions, was filled with a soap and water solution to prevent insect escape.

2.3.4. Insect Killing/Preservation: Insects were euthanized using ethyl acetate in a wide-mouthed jar, with two preservation methods employed: direct pinning for larger insects and pickling in a 50% ethanol solution for others.

2.3.5. Identification of Insects: Specimens were identified in the laboratory using relevant keys from references such as Bourlière (1976), Tanwar *et al*. (2010), and Terren *et al*. (2012).

2.3.6. Data Analysis: Descriptive statistics, including frequencies and percentages, were employed for data analysis. The One-Way ANOVA was used to assess variances in orders, families, and species. Diversity indices, such as species diversity, richness, and evenness, were utilized to evaluate species diversity and distribution.

3. Results

In this results section, the outcomes of the investigation into insect populations within a site contaminated with palm oil and spent engine oil effluents using diverse collection techniques are expounded.

3.1 Number of Insects in the Site Contaminated with Palm Oil Effluent Using Different Techniques

The result of the number of insects collected in the palm oil effluent site using different techniques is presented in Table 1. The result revealed that pitfall trapsrecorded higher number of insects (72.93%) than sweep nets (27.07%). The number of insects collected in site contaminated with palm oil effluent using pitfall traps was significantly higher when compared with sweep nets (P=0.001). The dataset further reveals a total of 3,886 insects distributed across diverse orders, families, and species. Notably, pitfall traps emerged as highly effective, capturing a substantial 72.93% of the overall population, leaving 27.07% for sweep nets. Within the Coleoptera order, the Carabidae and Chrysomelidae families displayed varying responses. Dichaeatochilus sp. and Lema cephalotes, for instance, exhibited higher captures in pitfall traps (1.13% and 2.65%, respectively) compared to sweep nets.

Table 1: Population of Insects in the Site Contaminated with Palm Oil Effluent Using Different Techniques

Order	Family	Species	Pitfall (%)	Sweep net (%)	Total(%)
Coleoptera	Carabidae	*Dichaeatochilus*sp.	32(1.13)	0(0.00)	32(0.82)
		Chalarnitesspendidus	53(1.87)	0(0.00)	53(1.36)
		Lonchostermuspolitus	70(2.47)	2(0.19)	72(1.85)
		*Orthogonis*sp.	20(0.71)	1(0.10)	21(0.54)
	Chrysomelidae	*Podagrica*	39(1.38)	0(0.00)	39(1.00)
		Lema cephalotes	75(2.65)	2(0.19)	77(1.98)
	Tenebrionidae	*Mesomorphussetosus*	58(2.05)	2(0.19)	60(1.54)
Diptera	Asilidae	*Nusa* sp.	53(1.87)	7(0.67)	60(1.54)
		*Laphria*sp.	13(0.46)	12(1.14)	25(0.64)
	Muscidae	*Musca domestica*	151(5.33)	156(14.83)	307(7.90)
	Sarcophogidae	*Sacrophagaexubens*	170(6.00)	162(15.40)	332(8.54)
		Sacrophag cruentata	167(5.89)	175(16.63)	342(8.80)
	Syrphidae	*Lathyropthalmustabanoides*	113(3.99)	109(10.36)	222(5.71)
	Tabanidae	*Tabaniustaeniola*	40(1.41)	41(3.90)	81(2.08)
Hemiptera	Lygacidae	*Naphiussp*	19(0.67)	19(1.81)	38(0.98)
	Miridae	*Adephocorisapicale*	4(0.14)	8(0.76)	12(0.31)
	Nabidae	*Prostemmafalkemsteini*	54(1.91)	62(5.89)	116(2.99)
	Reduvildae	*Acanthaspis*sp.	54(1.91)	70(6.65)	124(3.19)

Homoptera	Aphrophodidae	*Poophiluscostalis*	11(0.39)	17(1.62)	28(0.72)
Hymenoptera	Bracoridae	*Chelomusbiforeolatus*	102(3.60)	34(3.23)	136(3.50)
	Formicidae	*Camponotusacvapimensis*	208(7.38)	17(1.62)	225(5.79)
		Camponotusperrisi	326(11.50)	8(0.76)	334(8.59)
		*Crematogaster*sp.	252(8.89)	12(1.14)	264(6.79)
		Mjrmicariastiati	144(5.08)	8(0.76)	152(3.91)
	Ichneumonidae	*GymnogryllusLucens*	149(5.26)	11(1.05)	160(4.12)
	Vespidae	*Odynerus* Spp.	146(5.15)	8(0.76)	154(3.96)
Isoptera	Termitidae	*Reticulitermes* sp.	138(4.87)	5(0.48)	143(3.68)
Orthoptera	Acrididae	*Morphacrisfasciata*	43(1.52)	19(1.81)	62(1.60)
	Gryllidae	*Gymnogrylluslucens*	81(2.86)	51(4.85)	132(3.40)
	Tridactyllidae	*Tridactylusdigitatus*	49(1.73)	34(3.23)	83(2.14)
		Total	**2834(72.93)**	**1052 (27.07)**	**3886(100)**

In the Diptera and Hymenoptera orders, pronounced differences in collection efficiency between pitfall traps and sweep nets were evident. Musca domestica, a common housefly in the Muscidae family, recorded 151 captures in pitfall traps (5.33%) versus 156 in sweep nets (14.83%), highlighting the nuanced preferences of certain species for specific collection methods. Similarly, within the Hymenoptera order, various Camponotus species displayed differential responses, with pitfall traps yielding significantly higher captures than sweep nets. Camponotusacvapimensis, for instance, showed 208 captures (7.38%) in pitfall traps versus 17 (1.62%) in sweep nets.The stark contrast in the total numbers of insects collected underscores the critical role of methodological considerations in accurately assessing and monitoring insect populations in ecologically sensitive environments affected by industrial effluents.

3.2 Number of Insects in the Site Contaminated with Spent Engine Oil Effluent Using Different Techniques

The result of the number of insects collected in the spent engine oil effluent site using different techniques is presented in Table 2. The result revealed that pitfall trapsrecorded higher number of insects (80.61%)than sweep nets (19.39%). The number of insects collected in spent engine oil using pitfall traps was significantly higher when compared with sweep nets (P=0.001).Further, the data showcases a total of 820 insects distributed across various orders, families, and species. Notably, pitfall traps emerged as highly efficient, capturing a substantial

80.61% of the overall population, leaving 19.39% for sweep nets. Within the Coleoptera order, *Gymnopleurus* sp. and *Aulacoryssus* sp. exhibited notable captures in pitfall traps, with percentages of 3.18% and 8.17%, respectively, compared to zero captures in sweep nets.

Table 2: Number of Insects in the Site Contaminated with Spent Engine Oil Effluent Using Different Techniques

Order	Species	Pitfall (%)	Sweepnet (%)	Total (%)
Coleoptera	*Aulacryssus*sp.	11(1.66)	0(0.00)	11(1.34)
	Asbeceestanigripennis	20(3.03)	0(0.00)	20(2.44)
	*Aulacoryssus*sp.	54(8.17)	0(0.00)	54(6.59)
	*Gymnopleurus*sp.	21(3.18)	0(0.00)	21(2.56)
	Mesorphussetosus	17(2.57)	0(0.00)	17(2.07)
	Phrynocolusderitatus	24(3.63)	0(0.00)	24(2.93)
Dictyoptera	*Elaea*sp.	20(3.03)	4(2.52)	24(2.93)
Diptera	*Laphira*sp.	7(1.06)	3(1.89)	10(1.22)
	Tabamustaeniolu	22(3.33)	9(5.66)	31(3.78)
Hemiptera	*Dieuchessimilis*	9(1.36)	10(6.29)	19(2.32)
	*Graphtostethus*sp.	9(1.36)	8(5.03)	17(2.07)
	Adelpocorisapicalis	27(4.08)	18(11.32)	45(5.49)
	Macrina juvenca	12(1.82)	11(6.92)	23(2.80)
Homoptera	*Clania centralis*	9(1.36)	9(5.66)	18(2.20)
	Poophituscostalis	5(0.76)	13(8.18)	18(2.20)
Hymenoptera	*Apis mellifera*	61(9.23)	12(7.55)	73(8.90)
	*Chelonus*sp.	10(1.51)	0(0.00)	10(1.22)
	*Disophrys*sp.	11(1.66)	4(2.52)	15(1.83)
	*Chelorus*sp.	15(2.27)	1(0.63)	16(1.95)
	Camponatus maculatus	173(26.17)	9(5.66)	182(22.20)
	*Megaponera*sp.	38(5.75)	7(4.40)	45(5.49)
	*Tachysphex*sp.	9(1.36)	1(0.63)	10(1.22)
Orthoptera	*Leva soudanica*	19(2.87)	5(3.14)	24(2.93)
	*Spistarus*sp.	16(2.42)	28(17.61)	44(5.37)
Isoptera	*Reticulertermes*sp.	20(3.03)	2(1.26)	22(2.68)
	*Stobbea*sp.	22(3.33)	5(3.14)	27(3.29)
	Total	**661(80.61)**	**159(19.39)**	**820(100)**

In the Diptera order, *Laphira* sp. and *Tabamustaeniolu* displayed differences in collection efficiency between pitfall traps and sweep nets. *Laphira* sp. exhibited 1.06% and 1.89% captures in pitfall traps and sweep nets, respectively, while *Tabamustaeniolu* showed 3.33% and 5.66% captures, emphasizing the varied preferences of different species for collection methods.The Hymenoptera order also showcased diverse responses, with *Camponatus maculatus* standing out with 26.17% captures in pitfall traps compared to 5.66% in sweep nets. The overall efficiency of pitfall traps is further underscored by their success in capturing *Apis mellifera* (9.23%), *Adelpocorisapicalis* (4.08%), and Megaponera sp. (5.75%), among others.In the Orthoptera order, Spistarus sp. demonstrated a significant preference for sweep nets, with 17.61% captures compared to 2.42% in pitfall traps. The Isoptera order exhibited a balanced response, with Reticulertermes sp. and Stobbea sp. showing capture percentages of 3.03% and 3.33% in pitfall traps and 1.26% and 3.14% in sweep nets, respectively.This detailed breakdown provides valuable awareness into the differential responses of insect taxa to spent engine oil effluent contamination, emphasizing the importance of tailored collection methodologies for accurate ecological assessments.

3.3 Number of Insects in the Control Site with Using Different Techniques

The result of the number of insects collected in the control site using different techniques is presented in Table 3. The data encompasses various orders, families, and species, providing valuable awareness into the composition and distribution of insect communities.The result revealed that pitfall trapsrecorded higher number of insects (62.40%)than sweep nets (37.60%). The number of insects collected in control site using pitfall traps was not significantly higher when compared with sweep nets (P=0.23).In the Coleoptera order, Mesomorphissetosus stands out with a notable 16.02% capture in pitfall traps, contributing significantly to the total percentage of 62.40%. This highlights the efficacy of pitfall traps in capturing ground-dwelling beetles in uncontaminated environments.

Table 3: Number of Insects in the Uncontaminated Site Using Different Techniques

Order	Species	Pitfall (%)	Sweepnet (%)	Total (%)
Blattodea	*Reticulitermas*p.	34(3.32)	1(0.16)	35(2.13)
Coleoptera	*Lema affinis*	15(1.46)	0(0.00)	15(0.91)
	Mesomorphissetosus	164(16.02)	0(0.00)	164(9.99)
	Phrynocolusderitatus	33(3.22)	0(0.00)	33(2.01)
Diptera	*Chrynsonnia regalis*	27(2.64)	40(6.48)	67(4.08)
	Dichaetochitus	4(0.39)	22(3.57)	26(1.58)
	Musca domestica	17(1.66)	136(22.04)	153(9.32)
Heteroptera	*Asongopusviduatus*	16(1.56)	47(7.62)	63(3.84)
Hymenoptera	*Noma* sp.	8(0.78)	2(0.32)	10(0.61)
	*Microdus*sp	12(1.17)	0(0.00)	12(0.73)
	Camponotus maculatus	122(11.91)	0(0.00)	122(7.43)
	Camponotusperrisi	165(16.11)	0(0.00)	165(10.05)
	*Cremtogaster*sp	164(16.02)	2(0.32)	166(10.12)
	*Dorylus*sp	74(7.23)	3(0.49)	77(4.69)

	Mesor gala. Sp	111(10.84)	2(0.32)	113(6.89)
	PhidoleSp	10(0.98)	0(0.00)	10(0.61)
	Philanthustriangulum	14(1.37)	0(0.00)	14(0.84)
Lepidoptera	*Bareiaoculigera*	0(0.00)	12(1.94)	12(0.73)
	PlusiaFurcifera	32(3.13)	100(16.21)	132(8.04)
	UdeaSp	0(0.00)	6(0.97)	6(0.37)
Odonata	*Crocothemis divisa*	0(0.00)	75(12.16)	75(4.57)
Orthoptera	*Aulacoryssus sp.*	0(0.00)	33(5.35)	33(2.01)
	Gymnogryllusafrocanus	2(0.20)	48(7.78)	50(3.05)
	Melanogryllus sp.	0(0.00)	26(4.21)	26(1.58)
	Zonocerus variegatus	0(0.00)	62(10.05)	62(3.78)
	Total	**1024(62.40)**	**617(37.60)**	**1641(100)**

Diptera, represented by *Chrynsonnia regalis* and *Musca domestica*, exhibits interesting patterns. *Chrynsonnia regalis* shows balanced captures between pitfall traps (2.64%) and sweep nets (6.48%), while *Musca domestica* is predominantly captured in sweep nets (22.04%). This indicates the preference of certain Diptera species for aerial or ground-level habitats.Hymenoptera, featuring *Camponotus maculatus* and *Camponotusperrisi*, displays a significant capture percentage of 11.91% and 16.11% in pitfall traps, contributing to the overall diversity observed in the uncontaminated site.Lepidoptera, represented by *PlusiaFurcifera*, exhibits a noteworthy 16.21% capture in sweep nets. This emphasizes the importance of employing varied collection methods to capture a comprehensive range of insect taxa, especially those with different ecological niches.Orthoptera, including *Aulacoryssus* sp., *Gymnogryllusafrocanus*, and *Zonocerusvariegatus*, showcases diverse preferences for collection techniques. *Gymnogryllusafrocanus*, for instance, displays a notable 7.78% capture in sweep nets, underlining the importance of these nets in capturing certain Orthoptera species.The overall insect population in the uncontaminated site is dominated by pitfall traps, contributing to 62.40% of the total, while sweep nets account for 37.60%. This suggests that ground-dwelling and crawling insects are more effectively captured by pitfall traps, whereas those in flight or residing on vegetation are better captured by sweep nets.

4. Discussion

The study on site contaminated with palm oil effluent using different techniques highlights significant differences in insect collection efficiency between pitfall traps and sweep nets in a palm oil effluent-contaminated site. Pitfall traps captured a notably higher percentage of insects compared to sweep nets. This finding aligns with previous literature emphasizing the efficacy of pitfall traps in collecting ground-dwelling insects (Ahmed*et al*., 2023). The comprehensive analysis of 3,886 insects across diverse orders and families underscores the importance of employing diverse sampling methods for a holistic understanding of insect populations (Tobinand Robinet, 2022).Within the Coleoptera order, the Carabidae and Chrysomelidae families displayed divergent responses, with certain species exhibiting higher captures in pitfall traps compared to sweep nets. This observation is consistent with previous studies highlighting the habitat preferences of specific beetle species (Galko*et al*., 2018; Traylor*et al*., 2024).In the Diptera and Hymenoptera orders, notable differences in collection efficiency were observed. For instance, Musca domestica, a common housefly, showed nuanced preferences, highlighting the diverse ecological niches of insect species. Similarly, within the Hymenoptera order, Camponotusacvapimensis exhibited significant differences, emphasizing the importance of tailoring collection methods based on species-specific behaviors.

The study's findings regarding site contaminated with spent engine oil effluent using different techniques highlight notable disparities in insect collection efficiency between pitfall traps and sweep nets in a site contaminated with spent engine oil effluent. Pitfall traps exhibited a significantly higher efficacy in capturing insectscaptured by sweep nets. This outcome aligns with previous research emphasizing the effectiveness of pitfall traps in soil-dwelling insect sampling (Litavskýand Prokop, 2023).Within the Coleoptera order, Gymnopleurus sp. and Aulacoryssus sp. displayed substantial captures in pitfall traps, while sweep nets yielded zero captures. This discrepancy underscores the varied responses of beetle species to different collection methods, as noted in similar studies (Nervo *et al*., 2024). In the Diptera order, *Laphira* sp. and *Tabamustaeniolu* exhibited differing collection efficiencies between pitfall traps and sweep nets, emphasizing the nuanced preferences of these species for specific trapping techniques (ShwetaandRajmohana, 2016).The Hymenoptera order showcased diverse responses, with *Camponatus maculatus* demonstrating a preference for pitfall traps, aligning with findings in related studies (Jiménez-Carmona *et al*., 2019). The overall success of pitfall traps is further emphasized by their effectiveness in capturing various species, such as *Apis mellifera*, *Adelpocorisapicalis* and *Megaponera* sp., underlining the versatility of this method for different taxa (GardarinandValantin-Morison, 2021).Contrastingly, in the Orthoptera order, Spistarus sp.

showed a significant preference for sweep nets, highlighting the importance of considering species-specific behaviors in selecting collection methods (Spaffordand Lortie, 2013). The Isoptera order exhibited a balanced response, with *Reticulertermes* sp. and *Stobbea* sp. showing varying capture percentages in pitfall traps and sweep nets, indicative of the complexity in insect responses to environmental contaminants (Agathokleous*et al*., 2023; Ogbonna*et al*., 2023).

The dataset on insects in the control site with using different techniques presents a comprehensive exploration of insect communities, revealing awareness into their composition and distribution across various orders, families, and species. Notably, pitfall traps outperformed sweep netsemphasizing their efficacy in sampling ground-dwelling species in uncontaminated environments (Bertoia*et al*., 2023). In contrast, the Diptera order, represented by *Chrynsonnia regalis* and *Muscadomestica*, exhibited intriguing patterns. *Chrynsonnia regalis* demonstrated a balanced capture between pitfall traps and sweep nets, suggesting adaptability in habitat preferences, while Musca domestica was predominantly captured in sweep nets, indicating a preference for aerial or ground-level habitats (Mayr, 2017; PurbaandChasani, 2021).The Hymenoptera order, featuring *Camponotus maculatus* and *Camponotusperrisi*, displayed significant capture percentages in pitfall traps, contributing to the overall diversity observed in uncontaminated sites (Mukherjee*et al*., 2014). Meanwhile, Lepidoptera, represented by *Plusiafurcifera*, exhibited a noteworthy capture in sweep nets, emphasizing the importance of employing varied collection methods to comprehensively sample different ecological niches (Dvořák *et al*., 2022).Orthoptera, including *Aulacoryssus* sp., *Gymnogryllusafrocanus*, and *Zonocerus variegatus*, showcased diverse preferences for collection techniques. *Gymnogryllusafrocanus*, for instance, displayed notable captures in sweep nets, highlighting the importance of these nets in capturing certain Orthoptera species (Sperber*et al*.,2022). The dominance of pitfall traps in capturing ground-dwelling and crawling insects contrasts with the effectiveness of sweep nets in capturing flying or vegetation-dwelling insects, underlining the need for a methodological mix for a holistic assessment of insect communities in varied habitats (Rossetti*et al*., 2017).

6. Conclusion

In conclusion, the comparative study provides valuable awareness into the complex dynamics between anthropogenic pollutants and insect communities. Through a meticulous examination of palm oil and spent engine oil effluents, as well as the utilization of two distinct collection techniques, this research contributes to our understanding of the multifaceted consequences of industrial activities on terrestrial ecosystems.The findings underscore the significance of considering different aspects of insect diversity and behavior when assessing the impact of pollutants. Pitfall traps, which target ground-dwelling arthropods, revealed shifts in soil-dwelling insect communities in response to pollution, while sweep netting, capturing flying and perching insects, offered a broader perspective on the overall insect populations within vegetation. The complementary nature of these techniques highlights the importance of employing multiple methodologies to capture a comprehensive picture of insect responses to environmental stressors.

The study revealed that palm oil effluents exert a discernible influence on insect populations, with variations observed in abundance, diversity, and community structure. Similarly, spent engine oil, known for its persistent and toxic components, demonstrated distinct effects on insect communities. The comparative aspect of the research illuminated nuanced differences in the responses of insects to these two types of pollutants, emphasizing the need for targeted mitigation strategies based on the nature of the contaminant.Importantly, the study contributes to addressing existing gaps in the literature by focusing specifically on insect populations in the context of palm oil and spent engine oil pollution. While previous research has explored the broader ecological impacts of these pollutants, the intricate relationships between pollutants and insect communities have often been overshadowed. This research highlights the vulnerability of insects to anthropogenic disturbances and emphasizes their role as bioindicators of environmental health.

Furthermore, the study's results have practical implications for environmental management and conservation efforts. Understanding how insect populations respond to pollutants is crucial for predicting cascading effects on higher trophic levels and overall ecosystem stability. The comparative approach employed in this study provides a nuanced understanding of the synergistic or antagonistic effects that may arise from exposure to multiple pollutants simultaneously.In conclusion, the study not only advances our knowledge of the impact of palm oil and spent engine oil effluents on insect populations but also underscores the importance of selecting appropriate collection techniques for a comprehensive assessment. As we navigate an era of increasing industrialization, the awareness gained from this research contribute to the development of informed and targeted strategies for mitigating the environmental impact of human activities on insect biodiversity and, by extension, ecosystem health.

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