Uttar Pradesh Journal of Zoology

Volume 45, Issue 10, Page 43-49, 2024; Article no.UPJOZ.3304
ISSN: 0256-971X (P)

Arthropod Diversity of Municipal Solid Waste (MSW) in Ebonyi Waste to Wealth Company Abakaliki Ebonyi State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.56557/UPJOZ/2024/v45i104045

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.mbimph.com/review-history/3304

Original Research Article

Received: 01/01/2024
Accepted: 04/03/2024
Published: 24/04/2024

ABSTRACT

The study was designed to determine the diversity of arthropods in Ebonyi State waste to wealth Abakaliki, a municipal waste site (MWS) in Abakaliki where solid wastes of all sorts are deposited. The arthropod specimens were analysed using standard entomological technique of sweep net, pitfall traps and malaise trap respectively. Arthropod species identification was done morphologically at insect Museum Ahmed Bello University in Zaria. A total of 2000 arthropod specimens were collected comprising 8 orders, 18 families and 28 species. The most abundant species in diversity is *Bengalia gallard* 208 (10.4) followed by *Musca domestica* 205(10.2). Out of the 2000 individual species of arthropods collected from MSW dump site in Abakaliki, Diptera (48.30) and Hymenoptera (39.12) were the most prevalent while Dermaptera were the least in abundance. Four insect species were heterometabolic including medically important species, *Blattela sp.* (Blattodea). Insect Order Diversity in Respect to traps used for collection showed that

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pitfall trap with the total of 854 insects recorded the highest and Hymenoptera (43.2) recording the highest frequency. Shannon Weiner's Diversity Index of Insect Orders revealed that Diptera (0.48) had the highest diversity. Determination of the arthropod diversity in MSW will help in the control of possible vector borne disease epidemics especially in areas where there is no awareness of disease to its vector transmission.

Keywords: Arthropods; diversity; municipal solid waste; Abakaliki.

1. INTRODUCTION

"Municipal solid waste is defined as wastes consisting of everyday items. These wastes come from homes, institutions, and commercial sources, such as restaurants and small businesses. Some estimates suggest that each household waste production is approximately 800 g/d" [1].

"Open dumping and uncontrolled landfills, and even managed landfills, attract scavenging animals, insects, and other pests. The accumulation of municipal solid waste (MSW) creates an environment that is conducive to habitation and proliferation by various arthropods species. These arthropods could endanger human health through mechanical and biological transmission of pathogens" [2]. "Therefore, waste disposal by municipalities must be at regular intervals and through efficient and scientific methods to minimize the risks" [3].

"The act of indiscriminate and improper dumping of Municipal Solid Waste (MSW) is on the increase in urban areas and nearby communities in Abakaliki particularly and Nigeria at large" [4]. "This could be aided by large proportion of unhygienic people, urban drift, decreasing standard of living, poor legislation of government policies and no knowledge of the environmental effects of solid waste, and the end product of it all, in any available open space" [5].

Abd'Razack et al., [6] stated that "it has been observed that because of poor or improper land use planning in some part of many organically developed cities has resulted into the creation of informal settlement with narrow streets, which makes it difficult for waste collection trucks to access such areas" [7]. "Waste is dumped into the drainages that block the free flow of runoff water and this practice gives rise to flooding and the communities are adversely affected. Some people dumped their waste on the road side, thereby reducing the width of the road and esthetics of the cities especially in Nigeria. This is evident as one walks across the nooks and crannies of Nigeria; you find heaps of refuse littering the entire landscape, road sides, parks, gardens, commercial centres and other land use" [8]. The study is aimed at determining the Arthropod Diversity in Ebonyi waste to wealth company Abakaliki, Ebonyi State.

2. MATERIALS AND METHODS

The study was conducted in waste to wealth general dumpsite and open pits at Ohatekwe Ebonyi local government area Abakaliki Ebonyi State (37° 40′ N, 44° 58′ E), located about 15 km away from the Abakaliki metropolis. The landfill covers about 80 ha and has been in operation since 2013.

2.1 Methods of Fauna Collection

Arthropods were collected twice daily weekly between October- December 2022 using sweep nets, pitfall traps and malaise trap. Sweep netting was used for catching flying insects, whereas a pitfall trap was employed for collecting larger arthropods and crawling insects. Malaise traps were used for collecting high flying insect specimens. Pitfall traps (beaker bottles containing detergent and alcohol) were used based on the description of Azalia et al., [9].

2.2 Methods of Preservation and Identification of Insects

The insects were collected using pointed and blunt forceps and were preserved in the commonly used insect preservative, which is a mixture of 70% alcohol (70:30). The specimens were preserved in 70% ethanol and transported to the insect museum ABU Zaria.

3. RESULTS AND DISCUSSION

Habitat destruction and deterioration of habitat quality caused a severe decline of biodiversity, such as insect diversity which could be enhanced by solid waste management. Different insects were associated with different traps, the sweep net, pitfall trap and malaise traps across the solid waste field in Ebonyi state waste to wealth.

Fig. 1. Experimental sites

Ebonyi waste to wealth company is a general site where wastes of all sorts are gathered and a times scattered by some human scavengers. It is located less than 2km from Ebonyi state government house. It is made up of waste generated from households, shops, supermarkets, and open market places as termed Municipal waste. Habel et al., [10] further add that "solid waste disposal sites are found on the outskirts of the urban areas, turning into the child sources of contamination due to the incubation and proliferation of flies and rodents; that, in turn, are disease transmitters that affect population's health, which has its organic defenses in a formative and creative state. The said situation produces gastrointestinal, dermatological, respiratory, genetic, and several other kinds of infectious diseases" [11,12].

"In addition, habitat quality suffers strongly from various anthropogenic activities, such as nitrogen loads. In addition, the influx of various toxic substances such as pesticides have detrimental effects to the quality of habitats and have lethal effects on many plants and animal" Wagner [13].

The arthropod community in Table 1 showed that out of 2000 arthropods collected, 28 species, 18 families and 8 orders were collected from the three sites using different trap.

The result revealed that the period of the study was a dry season with hot temperature, high plane of the sites and high landscape may have caused low arthropod community fauna as recorded in this study. The result showed that out 2000 insect collected Diptera (48.30) has the highest relative abundance followed by Hymenoptera (39.12) while the least is Odonata (1.39). Diptera also recorded the highest dominance (48.30), 1.08 in margelef index diversity and 0.20 equitability. This is similar to the studies of Azalia et al., [9] who reported high dominance with low ratio in the margalef and equitability rankings. Similar studies in northern Ghana, Agyen- Sampong by N'Djolossen et al., [14] recorded 25 families and 46 genera of arthropod pests of sorghum, and Ebrahimet al., [15] and recorded 8 orders, 36 families and 56 genera of arthropods associated with shea trees in Northern Ghana. Kyerematen et al., [16] revealed 21 orders, 135 families, including 107 butterfly species. These values are in agreement with this result, even if one would have expected that overall diversity would be lower in our region than in the more humid zone.

This studies also collaborates with the arthropod diversity report of Amuda, et al., [17] who described 25 families and 46 genera of arthropod and studies at Kogyae Strict Nature Reserve (Forest Savanna Transition zone) recorded with 21 orders, 135 families, including 107 butterfly species Minghua et al., [18]. These values are in agreement with this result even if one would have expected that overall species richness would be lower in this region than in the more humid zones studied in those other regions.

The Table 2 in this study revealed that the relative abundance by order recorded that different orders collected, Diptera, Dermaptera, Coleoptera, Hemiptera, Hymenoptera, Odonata, Orthoptera and Dictyopteran were relatively high when compared to report from other areas. Whereas, the insect order recorded with the highest relative abundance is Diptera (48.30) followed by Hymenoptera (39.12). The arthropod

families captured includes Callophoridae, Scarabaeidae, Carabidae, Trachinidae, Muscidae, Sarcophagidae, Labiduridae, Blattoidae, Alydidae, Reduvidae, Vaspidea, Formicidea, Coriedea, Braconidae, Gryllidae, Libellulidae and Pyrgomorphidae. This result found Calliphoridae family to recording the highest diversity. Azalia et al., [9] in Indonesia similarly recorded same families Acrididae, Carabidae, Culicidae, Formicidae, Myrmicidae, Gryllidae, and Sphecidae from a landfill. This report disagrees with the study conducted in New Zealand, where the most prevalent family was Formicidae 48.6%, whereas in two other districts, Acrididae was the most prevalent family 53.5 and 67.2% frequencies, respectively [9]. Similarly, Banjo et al., (2012), in Northwest of Lagos, reported that arthropods belonging to the families of Muscidae, Culicidae, Blattidae, Scolopendridae, Diplopoda, Gryllidae, and Sparassidae were reported with high diversity [19].

The analysis in Table 3 showed the relative abundance of insects collected in MSW of Ebonyi State waste to wealth company. The role of insects in dumpsites is a relatively forgotten subject, and no studies have been conducted in this area regarding their diversity and public health importance. The result showed that a Dipteran of Muscidae family Bengallia gallard (10.4) recorded the highest, followed by Musca domestica (10.25) while Onchocephalus sp. and Anomala mixta (0.6) having the same frequency recorded the least relative abundance. Similar studies revealed that Houseflies (48.1%) and Cockroaches (29.5%), were the most abundant specie at a landfill in Nigeria Onyido et al., [20].

Table 1. Relative Abundance of Arthropods in MSW of Ebonyi State Waste to Wealth Company

Order	Family	Genus/Species	No: of individual	Relative abundance
Coleoptera	Scarabaeidae	Gymnopleurus sp.	32	1.6
		Heteronycus sp.	22	1.1
		Anomala mixta	12	0.6
	Carabldae	Arsinoe biguttata	51	2.55
		Chlaeniostenus sp.	29	1.45
		Dichaetochilus vagan	31	1.55
Diptera	Calliphoridae	Bengalia gallard	208	10.4
	Trachinidae	Glaurocara townsendi	71	3.55
	Muscidae	Musca sorbens	194	9.7
	“	Musca domestica	205	10.25
	“	Musca Lorosia	141	7.05
	Sarcophagida	Sarcophaga exuberans	121	6.05
		Sarcophagi inzi	134	6.7
Dermaptera	Labiduridae	Labidura riparia	28	1.4
Dictyoptera	Blattoidae	Blattela sp.	33	1.65
Hemiptera	Alydidae	Tenosius sp.	17	0.85
	Reduvidae	Oncocephalus sp.	12	0.6
Hymenoptera	Vaspidae	Hemispepsis vindex	66	3.3
	Formicidae	Camponotus sericeus	94	4.7
		Camponotus acvapimensis	111	5.55
		Messor galla	109	5.45
	Coreidae	Leptoglossus membranaceus	46	2.3
	Braconidae	Braunsia biluntata	81	4.05
Orthoptera	Gryllidae	Gryllus bimaculatus	46	2.3
	Pyrgomorphidae	Pyrgomorpha sp.	17	0.85
	Gryllidae	Gryllus africanus	22	1.1
Odonata	Libellulidae	Palpopleura lucia	43	2.15
		Bradinopyga Strochani	24	1.2
			2000	

Table 2. Insect order diversity indices in respect to MSW of Ebonyi State Waste to wealth company

Arthropod order	Total	Relative abundance	Dominance (%)	Evenness	Margalef index	Equitability
Diptera	626	48.30	48.30	0.20	1.08	0.20
Dermaptera	28	2.16	2.16	0.36	2.10	0.36
Coleoptera	26	2.00	2.00	0.37	2.15	0.37
Hemiptera	29	2.24	2.24	0.36	2.08	0.36
Hymenoptera	507	39.12	3.12	0.19	1.12	0.19
Odonata	18	1.39	1.39	0.42	2.42	0.42
Orthoptera	29	2.24	2.24	0.36	2.07	0.36
Dictyoptera	33	2.55	2.55	0.34	2.00	0.34
$\sum$	2000					

Table 3. Insect order diversity in respect to traps used for collection in MSW of Ebonyi State Waste to wealth Company

Insect order	Sweep net	Frequency (%)	Pitfall trap	Frequency (%)	Malaise trap	Frequency (%)
Diptera	626	89.6	235	27.5	235	50.1
Dermaptera	0	0	28	3.2	0	0
Coleoptera	26	3.7	113	13.2	38	8.1
Hemiptera	0	0	21	2.5	08	1.7
Hymenoptera	0	0	369	43.2	138	29.4
Odonata	18	2.5	31	3.6	18	3.8
Orthoptera	29	4.1	36	4.2	20	4.2
Dictyopteran	0	0	21	2.4	12	2.5
$\sum$	699		854		469	

Table 4. Shannon Weiner's Diversity Index of Insect Orders in MSW of Ebonyi State Waste to Wealth Company

Arthropod order	No. of individuals	Pi	lnpi	Pilnpi
Diptera	626	0.48	-0.73	-0.35
Dermaptera	28	0.02	-3.91	-0.08
Coleoptera	26	0.02	-3.91	-0.08
Hemiptera	29	0.02	-3.91	-0.08
Hymenoptera	507	0.39	-0.94	-0.37
Odonata	18	0.01	-4.61	-0.05
Orthoptera	29	0.02	-3.91	-0.08
Dictyoptera	33	0.03	-3.51	-0.11

Similar studies by Sukri et al., [21] in Urmia landfill Pakistan recorded some medically important families, at high density and observed that some of these insects played an important role in the food chain, especially as the revealers of decomposing organic materials while some play roles in keeping the balance of arthropods. The difference between the arthropods of diversity in this habitat to other areas, might be due to the different accessible food sources, climatic factors and other resource purses [22,23].

The occurrence of these medically important species in Abakaliki can affect human health directly (mechanical transmission) or indirectly (myiasis). Apart from understanding the diversity of insects associated with solid waste sites in Abakaliki, a good public health education to proper disposal of dump sites and informing the residents on the role of vectors in disease transmission is necessary [24].

4. CONCLUSION AND RECOMMENDATION

The study has therefore revealed that poor MSW disposal methods and management constitute

high risk factors to public health diseases. Improper handling of waste- both liquid and solid especially from the ranks of waste collectors and scavengers increases the risk to human health. This study which serves as the preliminary research on the arthropod diversity in waste disposal site will be able to establish a scientific proof that environmental characteristics and poor hygiene are statistically associated with environmentally related illness.

It is thereby needed to further the research to relate the disease transmission pattern mechanically by the insects collected from this area. Community people will be enlightened on sorting out waste before disposal, self- monitor waste disposal methods to ensure that indiscriminate waste disposal is prohibited among communities.

Application of good and perfect sanitary municipal solid waste, such as daily cover of (10–15 cm cover soil) and good final cover of (20–30 cm), perfect leachate collection and treatment system in landfill sites, and other management methods, can be used to control vectors breeding sites in Abakaliki.

A public orientation and awareness must be organized for communities and municipalities on proper handling of municipal waste (both solid and liquid) and disposal methods in a bid to stop open dumping of refuse, indiscriminate disposal of waste in streams and lakes.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Olukanni DO, Akinyinka OM. Environment, health and wealth towards an analysis of municipal solid waste management in Ota, Ogun State, Nigeria. Presented at the International Conference on Clean Technology and Engineering Management, Covenant University, Ota, Nigeria, ICCEM. 2012;51–71.
2. Seibold S. Arthropod decline in grasslands and forests is associated with landscape-level drivers. Nature. 2019;574:671–674.
3. Abbasi E, Rafinejad J, Hosseinpoor S, Gholami-Borujeni F, Gholizadeh S. Diversity of arthropods in municipal solid waste landfill of Urmia, Iran. Journal of medical entomology. 2019 ;56(1):268-70.
4. Olusegun Michael Ogundele, Opeagbe Mayowa Rapheal & Amusat Mudasiru Abiodun . Effects of Municipal Waste Disposal Methods on Community Health in Ibadan – Nigeria. Polytechnica. 2018;1:61–72.
5. Rachel OA, Komine H, Yasuhara K, Murakami S. Municipal solid waste management in developed and developing countries—Japan and Nigeria as case studies; 2009. Available:http://www.geo.civil.ibaraki.ac.jp/komine/mypapers/JGSPaper/2009/JGS2009(973)
6. Abd'Razack, Nelson TA. Yusuf, Agbu. E. Utange, Jonathan Z, Jonathan Z. An appraisal of solid waste generation and Management in Jalingo City, Nigeria. Journal Environment and Earth Science. 2013;3:9
7. Swapan MS. Socio-economic aspect of solid waste recovery and recycling in Bangladesh: a case study of Khulna City. Department of Urban and Regional Planning. In: Curtin University of technology; 2008.
8. Danbuzu SA. Composition and spatial distribution of solid waste collection point in urban Katsina, northern Nigeria. An M. Sclandresource (development). Research proposal submitted to the Department of Geography, Bayero University, Kano, Nigeria; 2011.
9. Azalia D, Setiawan H, Retnaningdyah C. Evaluation of ground arthropod structure in restoration area of Talangagung landfill as edutourism attraction, Kepanjen, Malang. Journal Indones. Tour. Developmental Studies. 2015;3:85–92.
10. Habel JC, Samways MJ, Schmitt T. Mitigating the precipitous decline of terrestrial European insects: Requirements for a new strategy. Biodiversity and Conservation. 2019;28:1343–1360.
11. Abul S. Environmental and health impact of solid waste disposal at Mangwaneni dumpsite in Manzini: Swaziland. Journal of Sustainable Developmental Africa. 2010;12(7).
12. Agyen-Sampong M. Insect pests of sorghum heads and assessment of crop loss by the major pests. Ghana Journal of Agricultural. Science. 2015; 11:109–115.

13. Wagner DL. Insect declines in the anthropocene. Annual Review. Entomology. 2020;65:457–480.
14. N'Djolossè K, Atachi P, Gnanglè CP. Inventory of insects associated with shea trees (*Vitellaria paradoxa*) (Sapotaceae) in central and northern Benin. International Journal of Tropical Insect Science. 2012;32:158–165.
15. Ebrahim A, Javad R, Saeed H, Gholami-Borujeni F, Saber G. Diversity of Arthropods in Municipal Solid Waste Landfill of Urmia, Iran Journal of Medical Entomology. 2019;56(1):268–270.
16. Kyerematen R, Owusu EH, Acquah-Lamptey D, Anderson RS, Ntiamoa-Baidu Y. Species composition and diversity of insects of the Kogyae Strict Nature Reserve in Ghana. OJE. 2014;4:1061–1079.
17. Amuda OS, Adebisi SA, Jimoda LA, Alade AO. Challenges and possible panacea to the municipal solid wastes Management in Nigeria. Journal of Sustainable Developmental Studies. 2014; 1:64–70.
18. Minghua ZF, Xiumin A, Rovetta H, Qichang F, Vicentini L, Bingkai A, Giusti LY. Journal Waste Management. 2009; 29:1227–1233.
19. Banjo F, A. Banjo, and B. Fasunwon. Survey of arthropod associated with refuse disposal sites in Ijebu-Ode, Ogun State. Current Research Journal of Biological Science. 2012;4:381–384.
20. Onyido A, Okolo P, Obiukwu M, Amadi E. A survey of vectors of public health diseases in un-disposed refuse dumps in Awka town, Anambra State, Southeastern Nigeria. Research Journal of Parasitology. 2009;4:22–27.
21. Sukri NC, Laras K, Wandra T, Didi S, RP, Larasati JR, Rachdyatmaka S, Osok P, Tjia JM, Saragih S. Hartati. Transmission of epidemic dengue hemorrhagic fever in easternmost Indonesia. American Journal of Tropical Medicine and Hygiene. 2003;68:529–535.
22. Akinremi ZO, Samuel FO. Knowledge and attitude of exclusive breastfeeding among hairdresser apprentices in Ibadan, Nigeria. British Journal of Medicine and Medical Research. 2014;5(3):376–385
23. Biesmeijer JC. Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands. Science. 2006;313:351–354.
24. Nabegu AB. An analysis of municipal solid waste in Kano Metropolis, Nigeria. Journal Human Ecology. 2010;31(2):113–116.

Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.mbimph.com/review-history/3304