EAS Journal of Parasitology and Infectious Diseases
Abbreviated Key Title: EAS J Parasitol Infect Dis
ISSN: 2663-0982 (Print) & ISSN: 2663-6727 (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-2 | Issue-1 |Jan- Feb-2020 |
DOI: 10.36349/EASJPID.2020.v02i01.001

Research Article

Public Health Importance of Insect Vectors in Open Dumps at the University of Port Harcourt, Nigeria

Abajue, M.C[*1], Okiwelu, S.N[1] and Noutcha, M.A.E[1]
[1]Entomology and Pest Management Unit Department of Animal and Environmental Biology, University of Port Harcourt, Nigeria

Article History
Received: 24.01.2020
Accepted: 04.02.2020
Published: 17.02.2020

Journal homepage:
https://www.easpublisher.com/easjpid

Quick Response Code

Abstract: Open dumps are becoming an acceptable norm in Nigeria where everything not usable is dumped irrespective of its consequence to humans and the environment. These dumps have become breeding sites for both vertebrate and invertebrate vectors, especially the insects. Insect vectors of public health importance at selected open dumps at the University Park, the University of Port Harcourt, Rivers State were collected with pan traps. Six insect orders (Coleoptera, Dictyoptera, Diptera, Hemiptera, Hymenoptera and Orthoptera), twenty-seven families and forty-five species were collected. The orders: Dictyoptera, (*Blatta orientalis*, *Blattella* spp.) and Diptera, consisting of mosquitoes (*Culex* spp.) and flies (*Musca domestica*, *Morellia nilotica*) are vectors of public health concern. Other insects with the potential of mechanical vectoring of pathogens include fruit flies (*Leucophenga* spp. and *Drosophila* spp). Insect species collected were moderately diverse and dominant in the dumps but were not evenly distributed. Environmental implications of open dumps are highlighted while the health implications of the insect vectors found in the dumps are discussed.

Keywords: Open dumps; insects; vectors; public health; Nigeria.

INTRODUCTION

Environmental consequences of open dumps and health implications of insects found in them and their management have been extensively documented to aid developing countries (Morales and Wolff, 2010; Camerini and Grappali, 2014; Chader and Keerti, 2017) alleviate outbreak of insect vector diseases. In Nigeria, domestic and hospital wastes constitute the major unsorted waste in open dumps and this may create high probability of water and soil pollution (Chader and Keerti, 2017).

In the past, refuse dumps were located on city outskirts but recently these areas have been occupied by the low income earners from the rural communities, creating city slums. Hence, the evacuation and management of the wastes have become more difficult because of man-power shortage and obsolete machinery, to move the wastes to covered dumps and incinerators. Wastes, irrespective of form (gas, liquid or solid) require professional and technical skills for proper management. In the tropics, insect vectors breed in open dumps that proliferate in cities. Studies on vertebrate and invertebrate vectors of refuse dumps abound in many prints and electronic media creating awareness of their impending health challenges. In Nigeria, Onyido *et al*. (2009) presented insects of refuse dumps that are vectors of public health importance while Ahmed, (2011) x-rayed the insect vectors of pathogens found in city refuse dumps that were threatening health of man and animals. Banjo *et al*. (2012) reported five arthropodan orders associated with refuse dumps to include Diptera and Dictyoptera (flies and cockroaches respectively) which were directly and indirectly involved in human diseases.

Urban solid wastes in Nigeria contain degradable and non-degradable components of plastics and kitchen wastes. In Port Harcourt, 0.45-1.16 kg/cap/day of municipal solid wastes consisted of 52-69% of organic wastes, 9.9-18.5% nylon bags and 1.5-8.3% of plastics (Babatunde *et al*., 2013). The non-degradable wastes (the polythene bags and plastic bottles) retain water and other organic debris as food source for cockroaches, flies and mosquitoes to breed in them. These plastics are a major cause of flooding in the cities by blocking the drainages and water ways during rainy season hence, impacting on the environmental scenery (Onifade and Nwabuotu, 2014). Ecologically, the animal biodiversity of dumps in Nigeria is critical to environmental sustainability (Oka and Bassey, 2017) and health. In essence, University of Port Harcourt dumps had not been thoroughly investigated for insects of public health importance, therefore, this study focuses on collecting and

***Corresponding Author:** Abajue, M.C Email: maduamaka.abajue [at] uniport.edu.ng

identifying insects of these dumps to extrapolate the insect vectors of Port Harcourt city dumps.

MATERIALS AND METHODS

Study Area

The study was conducted at the University Park of the University of Port Harcourt Choba, Rivers State Nigeria, June-August, 2018. University of Port Harcourt is located on the bank of the New Calabar River along the East-West road, at the northern limit of the coastal and deltaic swamp which lies on a relatively flat land in Choba, Obio/Akpor Local Government Area (LGA). It is contiguous with Ikwerre Local Government Area (Aluu Town) to the north, New Calabar River (which separates Obio/Akpor from Emohua Local Government Area) to the west, Alakahia town in Obio/Akpor L. G. A to the east (Fig. 1).

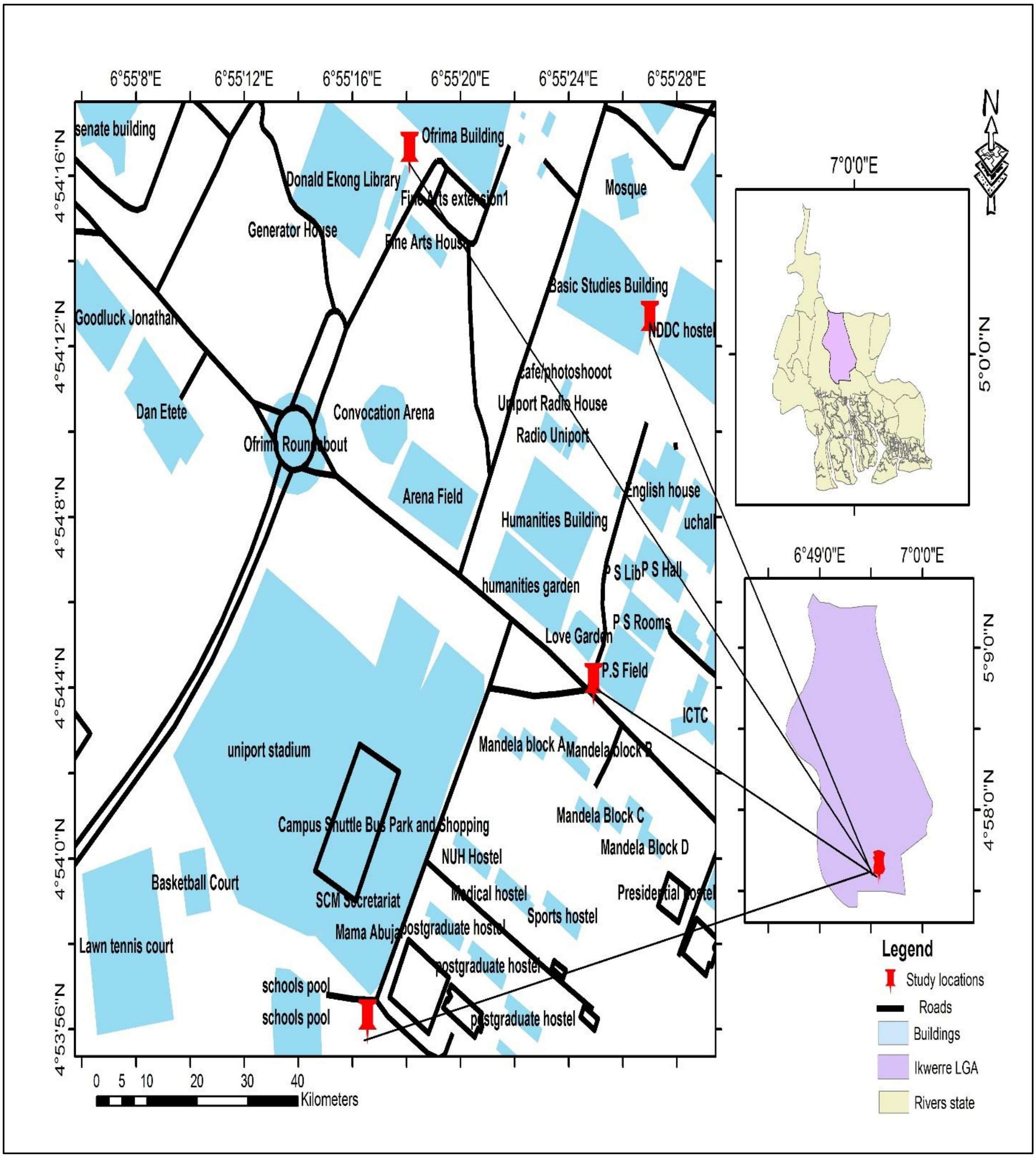

Figure 1. Study locations at the University of Port Harcourt

Insect collection, preservation and Identification

Collection of insects was done at four dumps at the University Park:

1. Behind the swimming pool (BSP)- N4^{0}53'56.166", E6^{0}55'16.5612"
2. In front of Faculty of Science (FFS) N4^{0}54'16.506", E6^{0}55'18.1128"
3. In front of Mandela Hostel (FMH) N4^{0}54'4.05", E6^{0}55'24.9168"
4. Behind the NDDC Hostel (BND) N4^{0}54'12.5388", E6^{0}55'27.0012"

The insects were collected with pan traps in the morning 07.00-08.00 hours, thrice weekly, June-August, 2018. The pan trap was a plastic bowl of 10 cm depth and 12 cm diameter. The bowl was filled to two-third (2/3) with water and 20 ml of 5% formalin added. In each of the four dumps, four pan traps (bowl with water and 5% formalin) were placed at the four corners of the dumps at FFS and FMH while pan traps were placed in a linear transect at intervals of 5 and 10 metres apart at the BND and BSP respectively because the dumps were irregular, close to the hostel walls and the walls of the perimeter fence of the swimming pool. The pan traps were placed on 45 cm-stands for 48 hours. Insects trapped in the pans were collected after reducing the solution with a 20 ml syringe. The insects at the bottom of the pans were collected with a blunt forceps and camel hair brush. The insects were placed in clean plastic vials and preserved in 70 % ethanol. After the final weekly collection, the insects were sorted and identified with a dissecting microscope to family level in the laboratory of the Department of Animal and Environmental Biology, University of Port Harcourt, Rivers State. At the end of the study, samples of the sorted insects were labeled and sent to a taxonomist at the Insect Museum, Ahmadu Bello University, Zaria for identification to species level. Weekly numerical data and locations were analyzed in percentile to estimate their relative abundance. The species diversity of the insects in the different dumps were calculated with Shannon and Simpson index of diversity.

H'= $\sum P_i \ln P_i$; D = $1/\sum(P_i)^2$; E = D/S; J = $H/\ln S$ and S = NS

Where H is the Shannon index, D is the Simpson Index, E is the Simpson evenness, J is the Shannon evenness or equitability and S is the species richness i.e. sum total number of the individual species in a population, N is the total number of individuals of all species.

RESULTS

The major solid wastes in the study locations were writing paper, polythene bags, plastic bottles, laboratory glass wares, disposable hand gloves, carcasses of experimental animals, syringes and needles from biological, chemical and physical laboratories. Others include; fish intestines, fruits, vegetables and sanitary materials at the rear of the hostels and the swimming pool. Wastes from offices at the Faculty of Science building were regularly removed by the University waste collectors while those from the laboratories and hostels dumped behind the faculty building and hostels respectively were not regularly removed except few that were dumped in the designated trash cans in front of the hostels. The wastes behind the swimming pool which comprised all the evacuated wastes from the entire University park had not been evacuated for over three years at the time of the study. Insects found in all the investigated dumps were abundant both in population and diversity. Hence, there were 45 species in 27 families and 6 orders (Table 1).

The dipteran families- Culicidae (12%), Muscidae (9.4%), Drosophilidae (9.4%) and Sciaridae (8.1%) were the most abundant. Blattellidae in the order Dictyoptera was (4.6%) and the least were Acaridae (0.1%) and Staphylinidae (0.4%) in the orders Orthoptera and Coleoptera respectively (Fig.2). Insect abundance across the dumps appear in Fig. 3. Behind the swimming pool (BSP) which served as consolidation dump of all wastes collected from the university waste, insect abundance was 45%, behind the NDDC (BND) hostel 39% and in front of Mandela (FMH) 12.9%. The least was in front of faculty of science (FFS) with 3.6%. The insect species were moderately diverse (1.84-3.09). However, their distribution was negative (-0.5 to -0.9), indicating that the species were not evenly distributed.

Table 1: Insect species collected at four selected open dumps at the University of Port Harcourt, Rivers State, June-August, 2018

ORDER	FAMILY	Species
Dictyoptera	Blattidae	**Blatta orientalis* Linn.
	Blattellidae	**Blattella* sp.
Coleoptera	Carabidae	*Hyparpalus juvencus* Dej.
		Lebia gabonica Chaud.
		Lonchosternus politus Gory.
		Metagonum subvirescens Laf.
	Chrysomelidae	*Aspidomorpha nigromaculata* Herbst.
		Gabomia sp.
	Coccinellidae	*Adonia variegate* Gze.
	Lagriidae	*Lagria villosa* Fab.
	Ptinidae	*Lasiodermini punctulatum* Steph.
	Scarabaeidae	*Apogonia nitidula* Thoms.
		Geotrupes sp.
	Staphylinidae	*Creophilus* sp.
		Sepeolophilus sp.
Diptera	Calliphoridae	*Chrysomya albiceps* Rob-Desv.
	Chloropidae	*Pachylophus lugener* W&H.
		Pachylophus lugens Loew.
	Culicidae	**Culex poicilipes*
		**Culex* spp.
	Drosophilidae	***Drosophila* sp.
		***Erima* sp.
		***Leucophenga* sp.
	Muscidae	**Musca domestica* Linn.
		**Morellia nilotica* Loew.
	Sciaridae	*Sciara* sp.
	Solvidae	*Solva* sp.
	Stratiomyidae	*Hermatia illucens* Linn.
		Tinda nigra Macq.
	Tephritidae	*Bactrocera invadens* Drew.
		Rhagoletis sp.
	Ulidiidae	*Chrysomyza smaragdina* Loew.
Hemiptera	Cicadellidae	*Platyretus tricolor* Walk.
Hymenoptera	Apidae	*Apis mellifera* Linn.
	Braconidae	*Cardiochiles niger.* W&H.
		Platyspathius spp.
	Encyrtidea	*Gen. nr.*
	Formicidae	*Camponotus peririsi* For.
		Camponotus sericeus Fab.
		Componotus spp.
		Pheidole spp.
	Tiphidae	*Elis* sp.
		Tiphia spp.
Orthoptera	Acrididae	*Paracomacris* sp.
	Gryllidae	*Gryllus* sp.

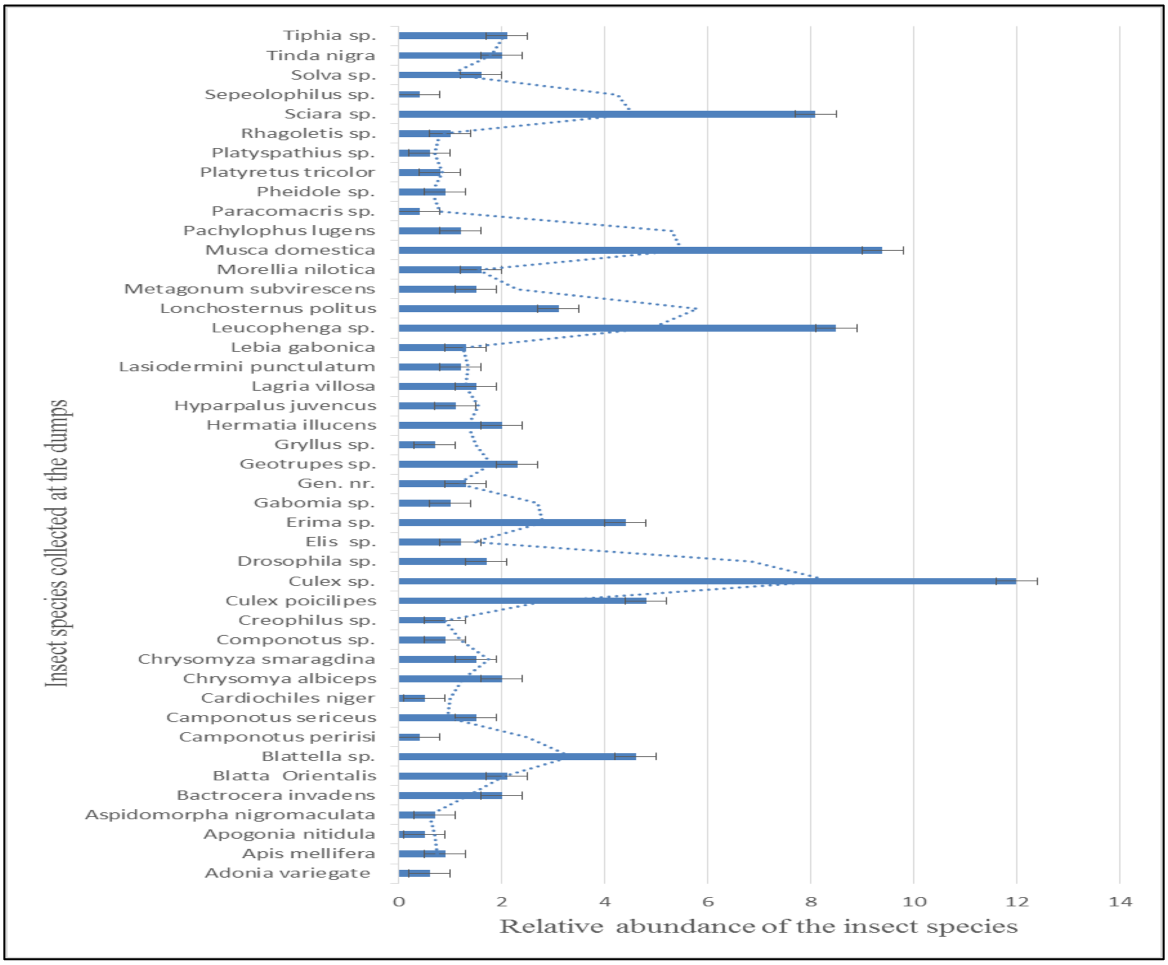

Figure 2. Relative abundance of insect species in open dumps at the University of Port Harcourt June-August, 2018

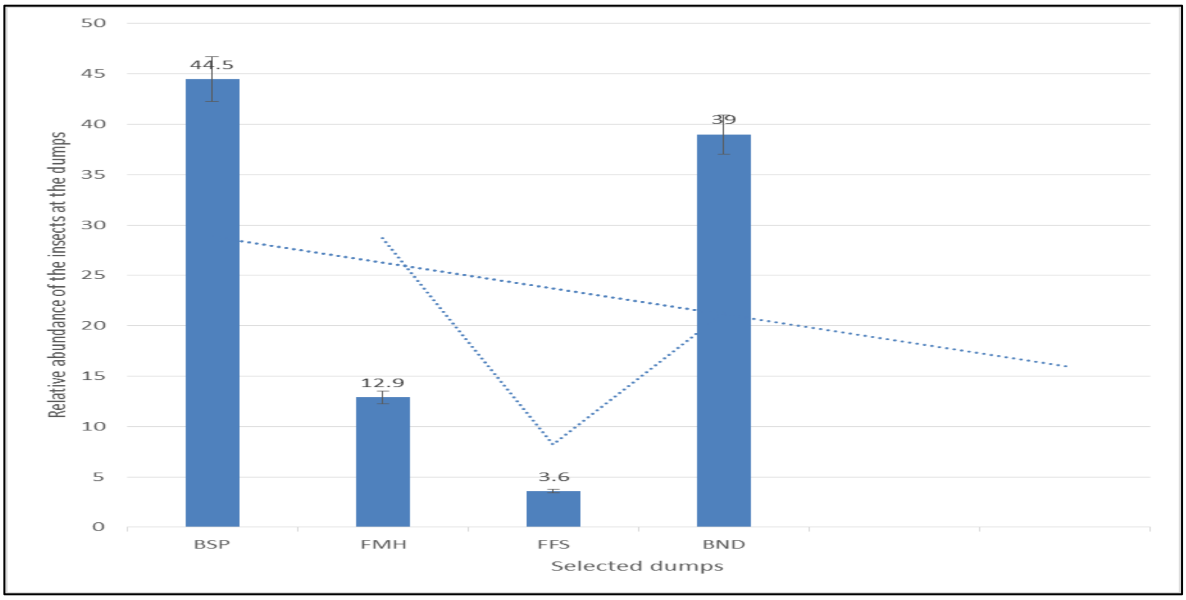

Figure 3. Relative abundance of the insects collected at the four selected open dumps at University of Port Harcourt June-August, 2018

Note: **BSP=** behind of swimming pool
FMH= front of Mandela Hostels
FFS= front of faculty of science building
BND= behind of NDDC hostels

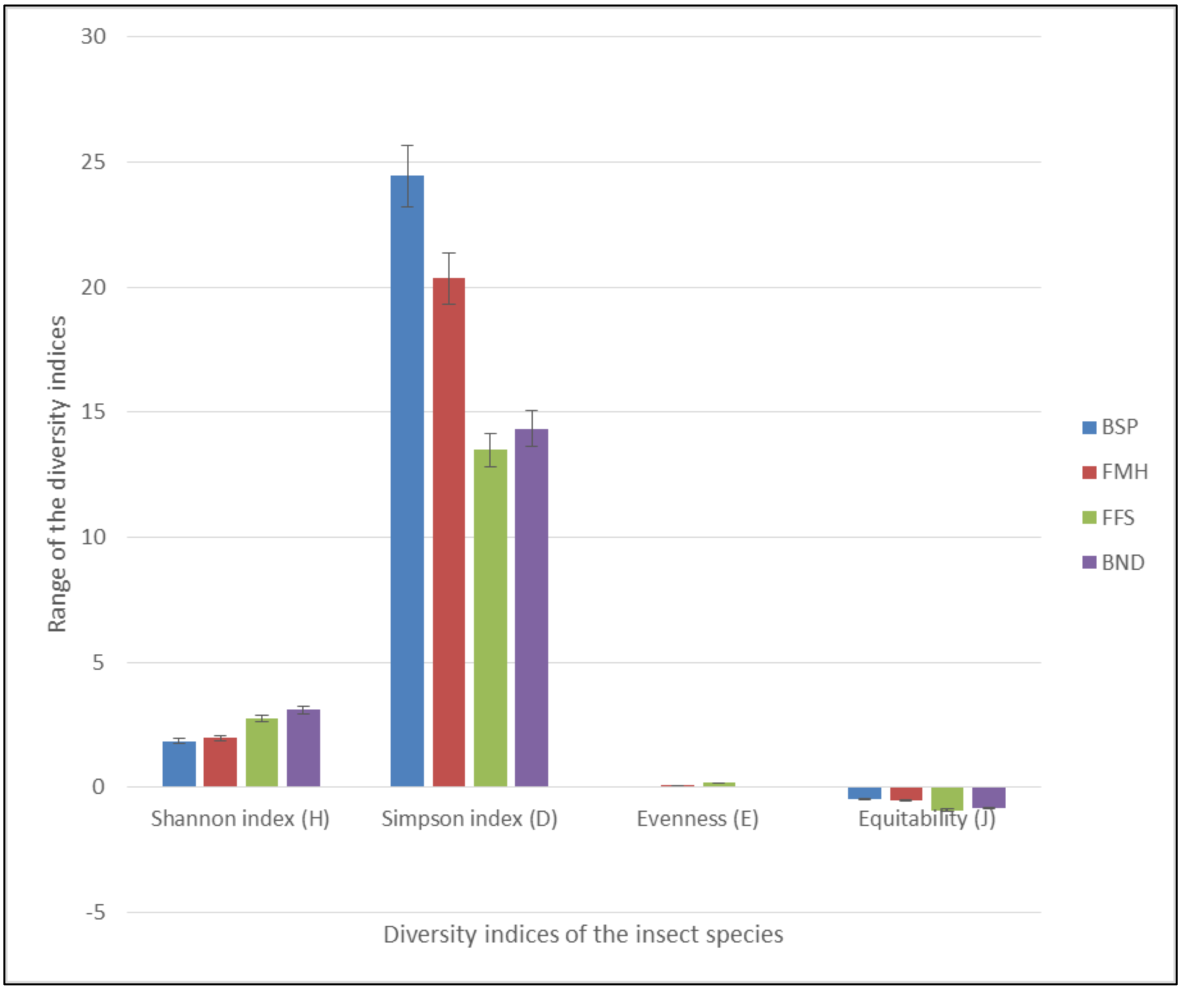

Figure 4. Diversity of insect species collected at the open dumps at the University of Port Harcourt June-August, 2018

Note: **BSP=** behind of swimming pool
FMH= In front of Mandela Hostels
FFS= In front of faculty of science building
BND= behind of NDDC hostels

DISCUSSION

Surveillance of insects associated with open dumps in the University of Port Harcourt revealed that the wastes especially the plastic materials contributed to the existence of insects of public health importance. The volume of the wastes and frequency of their evacuation determined to a great extent, the population of insects they inhabit and serving as breeding ground. Inappropriate use and disposal of garbage especially plastic materials potent public health threat. Resistivity of the plastics to bio-physical degradation places them as environmental nuisance. Owing to their degradable resistance, durability, affordability and versatility in forms have inevitably made them part of everyday life.

In this study, the fewer numbers of insects at FFS and FMH were due to regular evacuation of the wastes by the university waste collectors. Out of the 45 species of insects collected in the dumps, only cockroach, muscid and mosquito species are vectors capable of transmitting pathogens to humans and animals. The fruit fly species are another group of insects capable of transmitting diseases to humans, though not yet confirmed. These insect vectors have been reported to mechanically and biologically transmit pathogens of medical importance (Pach *et al.*, 1996; Pukkala and Ponka, 2001; Guevert *et al.*, 2006; Lakshikantha, 2006).

Ahmed (2011) reported that cockroaches transmit pathogens that cause amoebiasis, giardiasis and toxoplasmosis while Cotton *et al.* (2000) linked asthma-related allergy to cockroaches from open dumps in and around human dwellings. Ahmed (2011) further reported that houseflies deposit zoonotic and non-zoonotic protozoans such as *Saccystic* spp., *Toxopasma gondii*, *Isospora* spp., *Giardia* spp., *Entoamoeba* spp., *Eudolinax nana*, *Pentatrichomonas hominis*, *Hammonida* spp. and *Cryptosporidium pavuum* on food. Others include pathogens like Salmonella, Shigella, Campylobacter, Echerichia, Enterococcus and Chlamydia which are transmitted by houseflies.

Mosquitoes as reported are cosmopolitan but their preponderance is higher in the tropics and prefer to breed in plastic or porcelain containers, stagnant drainage systems, unused tyres, abandoned/not frequently used fish ponds, swamps, forest canopies, tree holes, refuse dumps containing plastic/porcelain containers (Benerjee *et al*. 2015; Ebuka *et al*. 2017). Mosquitoes have been known to suck blood and are classified as zoophilic or anthrophilic, feeding on animals and humans respectively (Service, 2012). They are important vectors of diseases such as malaria, filariasis, and viral diseases (Dengue, Japan encephalitis, West mile virus, Yellow fever, Zikka virus and Chikunguya). The prevalence of mosquito species on the investigated dumps is a serious health threat because of their ability to transmit diseases and therefore, need to be monitored to help predict their population variations for effective intervention. Assessing various breeding grounds for mosquitoes forms a very vital component in managing their population to reduce their rate of infection. This is necessary because the link between household wastes and the mosquito breeding enables characterization and classification of wastes as key larval habitats of mosquitoes (Banerjee *et al*. 2015).

CONCLUSION

Insect species in the open dumps studied were highly diversified and inhabit insect vectors of public health importance. The vectors are synanthropic, cosmopolitan and easily access anthropogenic wastes hence, may lead to disease outbreak. Household wastes tend to be higher in urban areas because of population density, social, economic and environmental factors. To reduce their abundance and health menace, government and concerned agencies should provide adequate machineries and manpower to prevent the vectors from accessing and breeding in open dumps by providing air tight receptacles, burying or burning the wastes in incinerators.

REFRERNCES

1. Ahmed, A.B. (2011). Insect vectors of pathogens in selected undisposed refuse dumps in Kaduna town, Northern Nigeria. Science World Journal, 6(4), 21-26.
2. Babatunde B. B., Vincent-Akpu I. F., Woke G. N., Atarhinyo E., Aharanwa U. C., Green A. F., & Isaac-Joe O. (2013). Comparative analysis of municipal solid waste (MSW) composition in three local government areas in Rivers State, Nigeria. African Journal of Environmental Science and Technology, *7*(9), 874-881.
3. Banerjee, S., Aditya, G., & Saha, G.K. (2015). Household wastes as larval habitats of Dengue Vectors: Comparison between Urban and Rural Areas of Kolkata, India. Plos one, *10*(10), e0138082.
4. Banjo, F.M., Banjo, A.D., & Fasuwon, B.T. (2012). Survey of arthropods associated with refuse disposal sites in Ijebu-Ode, Ogun State. Current Research Journal of Biological Science, *4*(4): 381-384.
5. Camerini, G., & Groppali, R. (2014). Landfill restoration and biodiversity: A case study in
6. Chadder, S.N., & Keerti, C. (2017). Solid waste pollution: A hazard to the Environment. Recent Advances in Petrochemical Science, 2(3) 555586.
7. Cotton, M.F., Wasserman, E., Pieper, C.H., Theron, D.C., van Tubbergh, D., Campbell, G., Fang, F.C., & Bames, J. (2000). Invasive diseases due to extended spectrumbeta-lactamase producing Klebsiella pneumonia in a neonatal unit: the possible role of cockroaches. Journal of Hospital Infections 44(1), 13-17.
8. Ebuka, K.E., Chukwudi, M.E., Uka, J., Chikezie, M.F., Anumba, J.U., Nwankwo, E.N., Obinna, C.A., Umenzekwe, C.C., Uchenna, E.Z., & Stella, I.A.I. (2017). Mosquito species associated with refuse dumps within Enugu Municipal, Enugu State, Nigeria. Journal of Mosquito Research, *7*(6), 39-47.
9. Guevart, E., Noeske, J., Solle, J., Essomba, J. M., Edjenguele, M., Bita, A., ... & Manga, B. (2006). Factors contributing to endemic cholera in Douala, Cameroon. Medecine tropicale: revue du Corps de sante colonial, *66*(3), 283-291.
10. Lakshmikantha, A. (2006). Reports on waste dumpsites around Bangalore. Waste Management, 26, 640-650.
11. Morales, G. E., & Wolff, M. (2010). Insects associated with the composting process of solid urban waste separated at the source. Revista Brasileira de Entomologia, *54*(4), 645-653.
12. Northern Italy. Waste Management and Research, 32(8), 782-790.
13. Onen, O. P., & Bassey, B. J. (2017). Biodiversity of City Dumpsites: What Future for the Environment?
14. Onifade, O.A., & Nwabuotu, F.A. (2014). Implications and causes of illegal refuse dumps in Ilorin South Local Government Area, Kwara State. Arabian Journal of Business and Management Review, *4*(2), 148-155.
15. Onyido, A. E., Okolo, P. O., Obiukwu, M. O., & Amadi, E. S. (2009). A Survey of Vectors of Public Health Diseases in Un-Disposed Refuse Dumps in Awka Town, Anambra State, South-eastern Nigeria. Research Journal of Parasitology, *4*(1), 22-27.
16. Pach, J., Kamenczak, A., & Panas, M. (1996). The frequency of toxic methemoglobinemias in people living in the vicinity of refuse dumps in Barycz. Przeglad lekarski, *53*(4), 348-350.
17. Pukkala, E., & Pönkä, A. (2001). Increased incidence of cancer and asthma in houses built on a former dump area. Environmental health perspectives, 109(11), 1121-1125.
18. Service, M. W. (2012). Medical entomology for students (5th. Ed.) Cambridge University Press.