

**Survey of Insect Vectors in Some Selected
Dumpsites in Gombe Metropolis, Nigeria,
Western Africa**

ABSTRACT

Aim: This study was conducted to determine the insect vectors living in refuse dumps at Gombe Metropolis in Gombe State of Nigeria.

Study Design: The metropolis were divided into four longitudinal zones, and in each zone three dumpsites were randomly selected. Visual observations were used to estimate the composition of the refuse dumps.

Place and duration of study: The study was conducted in Gombe metropolis of Gombe state between the months of May and August, 2018.

Methodology: Sweep nets, sticky traps, water traps and handpicking were used to collect different vector species. Specimen collected were preserved and transported to the laboratory for identification. Standard Identification keys were used for the identification of the vectors.

Result: The compositions of the refuse dumps varied from vegetable matter and animal remains to assorted materials including used tyres, electronic parts, cartons, faecal matter, broken bottles, polythene bags. A total of 464 insect vectors belonging to 9 species were collected. *Musca domestica* 282(60.8%) was the dominant species, followed by *Anopheles spp* 55(11.9%) and *Aedes species* 44(9.4%). *Periplaneta americana* accounts 37(8.0%) of the collections.

Conclusion: The thriving population of these vector species and the abundance of putrefying refuse dumps are risk factors of the endemic diseases transmitted by such vectors in the city. The present work therefore recommends the proper disposal of refuses to avert an epidemic status.

Keywords: Refuse dumps; nets; Musca domestica; Anopheles spp. Aedes spp; Periplaneta americana.

1. INTRODUCTION

Insects belong to kingdom Animalia and phylum Arthropoda. They are extremely diverse and play an important role in the ecosystem [1]. They have permeated the diverse and essential natural processes that uphold biological systems, making up over 75% of known species of animals. Indeed, the present ecosystem may not function without insect [2]. Insect vectors are those playing a role in the transmission of a pathogen between humans or from animals to humans [3]. The pervasive ecological importance of this great variety of insect makes them valuable to assess disturbance or environmental impacts of various kinds [4]. Mosquitoes are responsible for transmission of pathogens causing some of the most life-threatening fever and filariasis [5]. Cockroaches are found in nearly all habitats: tropical and temperate forests, grassland, heath, steppe, salt marshes, coastal communities, and deserts [6]. The house fly is very common and is a cosmopolitan species which transmit diseases to humans. House flies often live among filth and garbage, and can carry the pathogens for dysentery, typhoid, fever and cholera [7, 8]. Female flies deposit their eggs on decayed, fermenting or rotting organic material of their animal or vegetable origin. Garbage provide the main medium for breeding. The house fly *Musca domestica* is usually associated with decomposing substrate of solid urban

32 wastes [9]. *Musca domestica* are also implicated in the transmission of bacteria such as *salmonella*, *shigella*,
33 *campylobacter*, *Escherichia*, *Enterococcus*, *Chlamydia* and many other species that caused illness [7]. [10]
34 reported that *Musca domestica* visit human homes, crawl over food and household utensils, and deposit there
35 pathogens. Their survival and capacity to transmit diseases are directly linked to putrefying solid wastes. The
36 *Stomoxys calcitrans* have been reported to harbour a variety of pathogens that cause diseases in man and
37 animals such as viruses, bacteria, protozon, fugi, larvae and eggs of helminthes [11, 12]. The cockroaches
38 (family Balttidae) are known to feed on human faeces and transmit such diseases as *amoebiasis* caused by
39 *Entamoeba histolytica* [13]. A study by [14] showed that exposure to cockroach antigens may play an
40 important role in asthma-related health problems.

41
42 [15] defines waste as man's unwanted materials that need to be discarded. Waste has also been described
43 as substances and materials which are disposed off or are required to be disposed off according to the
44 provision of national law [16]. Dumpsites have been the most organized common methods of waste disposed
45 and remain so in many places in the world [17]. Reported by [18] every household produces certain amount of
46 waste or refuse daily. If this refuse is thrown outside the house, the breeding of animals vectors becomes
47 possible and this affects the health of community. [19] established that open dumping can reduce
48 environmental quality, and pose a threat to public health. On the other hand, [20] reported that many
49 countries in Africa do not have efficient waste collection and disposed service, what leads to both
50 environment and health problems.

51
52 In Nigeria the sources of solid waste are commercial, industrial, agricultural and educational establishment.
53 The consequences resulting from improperly managed waste include its serving as reservoir of pathogens,
54 habitat for pest such as rats, flies and mosquitoes, reduction of usable land area of the society, obstruction of
55 motorable roads and general nuisance and societal problems in residential areas [21]. Open dump of solid
56 waste is a common practice in Nigeria while some employ the service of stream to transport their solid waste
57 out of sight, some times directly dumping their solid waste by the roadsides. However, in some part of Nigeria,
58 refuse is generally buried, though some heedless burning is sometime observed [22]. [23] reported that
59 Kaduna metropolis is littered with refuse dumps. The predominance of houseflies, mosquitoes and
60 cockroaches in Ijebu-ode points to the possible mechanical transmission of disease [24].

61
62 All the eleven species of insects encountered in this study are closely associated with humans and human
63 generated waste. Despite the significant role that insect play in transmission of disease and their abundance
64 in the environment, only limited information about the species of insect commonly found in dumpsites in
65 Gombe metropolis is available. Consequently, it is required to survey insect vectors in some selected
66 dumpsites in Gombe. The present study identified insect vectors inhabiting dumpsites in Gombe metropolis,
67 Northeastern Nigeria.

68 69 2. MATERIAL AND METHODS

70 71 2.1 Study design

72 The study was conducted in Gombe metropolis, Gombe State Nigeria. The metropolis is located between
73 latitude 12° 8'and 10°24'N longitude 11° 22 and 11° 24'E. Altitude 500 meters above sea level. Gombe city
74 has over one hundred refuse dumps scattered all over the metropolis. The studied sites were selected based
75 on random selection. The metropolis were divided into four longitudinal zone and in each zone three dumpsite
76 were randomly selected. The location were Jekadafari, Orji Quarters, Tumfure, Herwagana, Bolari, Madaki,
77 Tudunwada, Arawa, Kagarawal, Kanayel, Nassarawo and Usman Farouk Quarters.

78 The locations and composition of the refuse dumps studied are shown in Table 1. The refuse varied in their
79 compositions according to human activities in the area.

80 The following methods were used for vector collection: sticky traps, water traps, sweep nets and handpicking
81 method as prescribed by [25].

82 Sticky traps: The sticky traps were used for trapping smaller insects and cockroaches. The sticky trap was
83 designed with plywood of about 60cm length, 40cm breadth and 2cm thickness. The surface of the plywood

84 was coated with grease and was placed on the surface of the refuse so that the insects were caught when
85 they crept into or were blown onto the sticky surfaces by wind.

86 Water traps: The water traps were made using plastic buckets of five liters, which were almost filled with
87 water. Detergent was added to the water to reduce surface tension and enhance wetting of the insects.

88 Sweep net: This was used for catching mosquitoes, houseflies and other flying insects. The sweep nets were
89 made with mosquito net and metal rods to form the rim and a wooden handle.
90 An average of about 20 sweeps were carried out at a dump between 8.00am and 10.00am in the morning for a
91 better catch.

92 Hand picking: This was used for catching cockroaches.

93 Samples were collected in the morning between 8-10am.

94 Preservation and Identification: Cockroaches, houseflies and other animals were kept in specimen bottles
95 containing 70% ethanol, while mosquitoes were kept in a Petridish containing filter paper placed over moist
96 cotton wool. And were taken to Zoology Laboratory, Gombe State University for Identification using insect
97 atlas and Identification Keys [26, 27].

98

UNDER PEER REVIEW

99 **3. RESULTS AND DISCUSSION**

100

101 **3.1 Results**

102 The locations and composition of the refuse dumps studied are shows in **Table 1**.

103

104

Table 1: Location and composition of different refuse dumps at Gombe metropolis

LOCATIONS	DESCRIPTIONS	COMPOSITION OF REFUSE DUMP
JEKADAFARI	High density area, poor planning and poor drainages inhabited by traders, top and low civil servants.	Used cans, vegetable matters, disposable cups, pots and plates, broken dishes, polythene bags, plastics, papers, old tyres etc.
ORJI QUARTERS	Residential homes, mostly civil servant and student with good drainage system.	Household garbage, pieces of clothing, broken bottles, and polythene bags etc.
TUMFURE	High density area, better planned and blocked drainage	Used can, household garbage, polythene bags, plastics, broken

	with both commercial and residential buildings.	bottles, empty tins and old tyers etc.
HERWAGANA	High density area with poor drainage and poor planning, mostly inhabited by traders, schools and residential houses.	Household garbage, empty cartons, pieces of clothing, vegetable matters, polythene bags, and old tyers.
BOLARI	High density area with poor drainage and poor planning, inhabited by traders and low civil servant.	Faecal matter, vegetable matter disposable pots and plates, broken dishes, polythene bags and plates, broken dishes, polythene bags etc.

UNL

MADAKI	High density area with poor drainage and poor planning, mostly inhabited by low civil servant and some traders	Faecal matter, household garbage, disposable pots plates and cups, polythene bags, plastics metals, used tyers, pieces of clothing, broken bottles etc.
TUDUNWADA	High density area with poor drainage and poor planning, inhabited by both low and top civil servant and traders	Vegetable matters, polythene bags, used tyres, faecal matter, disposable pots, cups and plates broken dishes.
ARAWA	High density area with poor drainage and poor planning, inhabited by both top and low	Faecal matter, household garbage, polythene bags, broken wooden furniture's, disposable cup sand

	civil servant and some traders	plates, used tyers, broken bottles, pieces of clothing etc
KAGARAWAL	High density area with poor drainage and poor planning, open defecation, inhabited by traders and low civil servant	Faecal matter, household garbage, old tyers, Polythene bags, plastics, broken bottles, broken dishes, disposable cups, plates and ports etc.
NASSARAWO	High density area, poor planning and poor drainage inhabited by both low and top civil servant and traders	Used tyers, faecal matter, food waste, polythene bags, plastics, household garbage vegetable matters etc.
USMAN FARUK	High density area poor planning	used can, vegetable matters,

QUARTERS	and poor drainage inhabited by traders and civil servant	disposable cups, pots and plates, broken dishes, polythene bags, plastics, papers, old tyres, faecal matters etc.
KANOYEL	High density area with poor drainage and poor planning, inhabited by both low and top civil servant and traders	Vegetable matters, polythene bags, used tyres, faecal matter, disposable pots, cups and plates broken dishes.

105
106
107
108

Figs. 1-5 highlight the cross-section of some selected dumpsites where the insects vectors were collected.

UNDERP



Fig. 1. Madaki dumpsite



Fig. 2. Nassarawo dumpsite



109
110
111
112

114
115

Fig. 3. Jekadafari dumpsite



Fig. 4. Arawa dumpsite

116
117
118
119
120
121
122
123
124

Fig. 5. Herwagana dumpsite

Table 2 shows the different species of insect which were collected from different refuse dumps. Nine different species were collected from different refuse dumps and also the species of insect varied in the different refuse dumps *M. domestica*, *Anopheles spp* and *P. americana* are collected in all the study sites.

Table 2: Insects collected from different refuse dumps

LOCATIONS	VECTOR SPECIES								
	<i>Anopheles spp.</i>	<i>Aedes spp.</i>	<i>Culex spp.</i>	<i>M.</i>	<i>F.</i>	<i>S.</i>	<i>O.</i>	<i>P.</i>	<i>S. longipalpa</i>
				<i>domestica</i>	<i>scalaris</i>	<i>calcitrans</i>	<i>lencostoma</i>	<i>americana</i>	

Kagarawal	5	4	2	16	4	-	-	6	2
Herwagana	4	4	-	13	-	1	-	3	-
Orji Quarters	3	1	1	12	-	1	-	2	-
Bolari	3	7	1	36	2	1	-	4	4
Usman Faruq Q.	5	3	2	17	1	-	-	4	-
Arawa	7	2	1	22	-	-	-	2	-
Tudunwada	8	4	2	18	1	-	-	2	-
Tumfure	3	4	3	16	-	-	-	2	-
Madaki	6	2	2	48	2	-	-	4	3
Nassarawo	2	7	1	6	-	-	-	2	2
Jeka fari	3	4	2	14	-	3	1	2	-
Kanoyel	6	2	-	64	-	-	1	4	-
Total	55	44	17	282	10	6	2	37	11
Percentage	11.9	9.4	3.7	60.8	2.1	1.3	0.4	8.0	2.4

125
126
127
128
129
130
131

Table 3 shows the different insect species collected using different method. Mosquitoes and some flies were collected using sweep nets, while cockroaches were collected using sticky trap and hand picking. Most of the flies were collected using water trap. Most of the insects were collected using water trap which has (59.9%), followed by sticky trap (30%), and then, sweep net (9.3%). Handpicking has the least percentage (0.8%) which shows that only few insects were collected using this method.

Table 3: Insect collected using different method

Vectors species	Hand picking	Water trap	Sticky trap	Sweep net	Total	Percentage
-----------------	--------------	------------	-------------	-----------	-------	------------

<i>Anopheles spp.</i>	-	-	-	55	55	11.9
<i>Aedes spp.</i>	-	-	-	44	44	9.4
<i>Culex spp.</i>	-	-	-	17	17	3.7
<i>M. domestica</i>	-	259	-	23	282	60.8
<i>F. scalaris</i>	-	10	-	-	10	2.1
<i>S. calcitrans</i>	-	6	-	-	6	1.3
<i>O. lencostoma</i>	-	2	-	-	2	0.4
<i>P. Americana</i>	4	-	33	-	37	8.0
<i>S.longipalpa</i>	-	-	11	-	11	2.4
<i>Total</i>	4	277	34	139	464	
<i>Percentage</i>	0.8	59.9.	9.3	30.0		100%

132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150

3.2 Discussion

The identified dumpsites in this study are at varying decomposing stages. This is perhaps an indication of poor sanitary condition in the town. [28] noted that the greatest challenge to the environmental health are those of municipal solid waste and human excreta. The negative effect of uncontrolled dumping of wastes in developing countries has been a great threat to public health [29, 25]. The composition of the dumpsites in this study agrees with that of Onyido *et al.*, (2009). Reports of [30] from Bangalore highlighted the danger of waste disposal sites in the spread of diseases to people living in the immediate vicinity. [10] observed that waste increase the incidence of cancer and asthma in houses built in sites that have been previously used as refuse dumps. Moreso, [31] highlighted that refuse dumpsites constitute a habitat for vectors and nuisance organisms that are capable of acting as transmitters of diseases. Nine (9) insect species including *M.domestica*, *P. americanus*, *Aedes spp*, *Culex spp*, *Anopheles spp*, *F. scalaris*, *S. calcitrans*, *O. lencostoma* and *S. longipalpa* were collected from the dumpsites. *M. domestica*, was the most abundant species collected. This finding agree with that of [32], where they reported the high frequency of *M. domestica*. This indicates the probable endemicity of diseases transmitted by these vectors in the city as the environmental conditions (warm humid climate), etiological sources of infection (faecal materials in the refuse) and human population for the maintenance of infections abound. Out of the nine species collected *M. domestica* and *P. Americana* were encountered in all the study sites, this also agree with that of (24). The predominance of houseflies and *P. americana* revealed possible mechanical transmission of diseases. Apart from *M. domestica*, *Anopheles species* are the most abundant species of insect collected in the survey sites; this also corresponds with the finding of [24], where they reported the relative abundance of mosquitoes breeding in the water holding containers found in the refuse dumps as an indicative that malaria and other mosquitoes borne diseases will be prevalent in the area. On the other

151 hand, this disagree with the result of [23], where they stated that *Aedes* mosquitoes, the vector of yellow fever were the only species
152 encountered in their study. A possible reason for their absence could be the absence of water holding containers for the female to lay eggs.
153

154 **4. CONCLUSION**

155
156 This study revealed that the undisposed dumpsites in the metropolis house numerous insect vectors. Abundance of these insect vectors in
157 the different dumpsites is worrisome. There is a need of intense public health education in Gombe metropolis especially

UNDER PEER REVIEW

158 concerning the numerous common insect vectors and their role in the transmission of
159 pathogens to humans. Proper management of waste is particularly necessary. Waste
160 recycling is a good alternative of waste management. Households should be encouraged to
161 dispose their dumps appropriately to minimize incidence of epidemics of diseases.
162

163 **COMPETING INTERESTS**

164
165 All Authors declare having no competing interests exist.
166

167 **ETHICAL APPROVAL**

168
169 Ethical approval was obtained from the Ethical Committee, Department of Biological
170 Sciences, Gombe State University.
171

172 **CONSENT**

173
174 It is not applicable.
175

176 **REFERENCES**

- 177
178
179 1. Finnamore, A.T. (1996). The Advantages of Using Arthropods In Ecosystem
180 Management A Brief From The Biological Survey Of Canada (Terrestrial Arthropods)
181 Upp. <http://www.Wikipedia.Org/Spread>.
182 2. Wiggins, G.B, S.A. Marshal, and J.A Duwnes. (1991). The Importance of Research
183 Collections of Terrestrial Arthropods. A Brief. *Bulletin of the Entomological Society of*
184 *Canada* 23 (2) Supplement. 16pp.
185 3. WHO. (2001). Weekly Epidemiological Reachrd, Vol. 76, No 25, Zool.
186 4. Lehmkuhl, D.M., H .V Danks, V.M behanapelletier, D.Y Larson, D.M Rosenbergi and
187 I.M Rosemergi and I.M Smith. (1984). Accommodations for the Appraisal of
188 Environmental Disturbance: Some General Guide Lines and the Value and
189 Feasibility of Insect Studies. A Brief. *Bulleting of the Entomological Society of*
190 *Canada* 16(3), Supplement 8pp.
191 5. Larissa, E. Collins and Alison Blackweel (2000). The biology of Toxorhyn chites
192 Mosquitoes and Their Potential as Bio Control agents. Departments of Biological
193 Sciences, University of Dundee, UK Vol. Uno 4. 105 N – 116N.
194 6. Roth, L. M. (2003). Blattodea (Cockroaches). In Grzimek is Animal Life
195 Encyclopedia. Vol. 3.M Hytchins, D.A Thoney, and M.C. Mc Dade, Editors. Gale,
196 Detroit. 147-159.
197 7. Service, M. (2012). Medical Entomology for Students. Fifth Edition. Cambridge
198 University Press. The Eidinburge Building Cambridge, UK p. 303.
199 8. Sarwa, M. (2014). Defeating Malaria with Preventative Treatment of Disease and
200 Deterrent Measures against Anopheline Vectors (Diptera: culiadge). *Journal of*
201 *Pharmacology and Toxicological Studies*, 2(4): 1-6.
202 9. Morales, G.M & Wolf, M. (2010) Insect Associated With Composting Process of
203 Solid Urban Waste Separates at the Source. *Revista Brasileira de Entomological* 54
204 (4): 645-653.
205 10. Pokkala, E. and A. Ponka, (2001). Increase Incidence of Cancer and Asthma in
206 House Built on a Former Dump Area. *Source. Environmental Health Perfect*; 109
207 (11): 1121-1125.
208 11. Philpoot, M. Ezeh, A.O. (1978). The Experimental transmission by Musca and
209 Stomokeys Species of D. Congolensis Infection between Cattle. *British Veterinary*
210 *Journal* 134 (6): 515 – 520.

- 211 12. Ogbonna, D. N., I. Ekwezor and F.U. Igwe, (2002). Waste Management: A Tool for
212 Environmental Protection in Nigeria. *Ambio*, 31 (1): 55-57.
- 213 13. Rao, C.K.A.: Krishnaswani, K.: Gupta, S.R.: Biswass, H. &Raghavan I.N.G. (1971)
214 Prevalence of Amoebiasis and other Intestinal Parasitic Infections in a Selected
215 Community. *Indian Journal of Medical Research* 59: 1365-1373.
- 216 14. Cotton, M.F; Wasserman, E; pieper, C.H.; C.H.; Theron, D.C.; Van Tubbergh, D.J
217 Campheli, a.i Fang, F.C & Barnes, J. (2000). Invasive Diseases Due to Extended
218 Spectrumbeta-la Ctamase Producing Klebsiella pneumoniae in Neonatal Unit: The
219 Possible Role of Cockroaches. *Journal of hospital infections* 44 (1): 13-7.
- 220 15. Miller, G.T. (1994). Living in the Environment: Beement, California Wads Worth
221 Publishing Company: 78-83.
- 222 16. Adegoke, (1990). Wastea Management within the Context of Sustainable
223 Development. In Aina and adedipe (eds). The Making of the Nigerian Environmental
224 Policy, FEPA Monograph. Pp 103-117
- 225 17. El-fadel. M., Findikakis. A.N.and Leckie. J.O. (1995). Environmental Impacts of Solid
226 Waste Land Filling, *Journal of Environmental Management*.
- 227 18. Sarojini, T.R., (2005) Refuse Disposal. 3rd Edn., ATP Africana First Publishers Ltd.,
228 Owerri, Nigeria, pp: 1-528
- 229 19. Jung. H; Mastuto.T. and Tanakaim (2005). Behavior of Metals in ash Melting and
230 Gasification- Melting of Municipal Solid Waste (MSW). *Waste Management*
231 25.pp.301-310.
- 232 20. Babayemi. J.O. and Dauda. Kit. (2009). Evaluation of Solid Waste Generation
233 Categories and Disposal Options in Developing Countries, A case study of Nigeria.
234 *Journal of applied science and environmental management* 14-(1):83-88.
- 235 21. Oyedele, O. (2009). Solid Waste Management as Engine for Industrial Development
236 in Nigeria.
- 237 22. Igoni, A.H., M.J Ayotamuno, S.O.T. Ogaji and S.O. Probert, (2007). Municipal solid
238 waste Management in Pathercout. *Nigeria Appl. Energy. Elsevier*, 84(6): 664-670.
- 239 23. Ahmed, A. B. (2011) Insect Vectors of Pathogens in Selected Undis posed Refuse
240 Dumps in Kaduna town *Northern Nigeria J. Sc.* Vol. 6 (No. 4).
- 241 24. Banjo, F.M., Banjo, A.D., and Fasunwon, 'B.T., (2012). Survey of Arthropod
242 Associated with Refuse Disposal Sites in Ijebu-Ode, Ogun State. *Journal of Science*
243 4 (4); 381-384.
- 244 25. Onyido, A.E. Okolo, P.O., Obiukwu, M.O and Amadi, E.s (2009) A Survey of Vectors
245 of Public Health Disease in Undisposal Refuse Dumps in Awka, Anambra State
246 South Eastern Nigeria *Research Journal of Parasilogy*; 4 (1): 22-27.
- 247 26. Folsom, Justus Watson. 1922. Entomology with Special References to its Ecological
248 Aspects. 3rd Edition. P. Blakiston's Son & Co, Philadelphia.
- 249 27. Borror, Donald J., Charles A. Triplehorn, and Norman F. Johnson. 1989. An
250 Introduction to the Study of Insects. Harcourt Brace College Publishers, New York.
- 251 28. Obionu, C. N. (2004) Sustainable Health Environment: The Challenge of our time.
252 Proceeding of the Annual Conference of EHOAN, Nov. 8-10 Anambra State Chapter
253 held at Ikenga Hotels Awka.
- 254 29. Siboe. G.M; Kimetti and C. Bii, (1996). The Role of Air-borne Fungal Shoves from
255 Garbage Dump in Respiratory Disease. *Afry Health Sci*; 3: 74-76.
- 256 30. Lakshmikantha, H. (2006). Report on waste dump sites around Bangalore. *Waste*
257 *Management* 26:640-650.
- 258 31. Pach, J.; Kamenczak, A. & Panas, M. (1996). The frequency of toxic
259 metnemoglobinemias in people living in the vicinity of refuse dumps in Barycz.
260 *Przegl Lek*, 53: 348-350.
- 261 32. Onyido, A.E., Azubuike, J., Amadi, E.S., Obiukwu, M.O., Ozumba, N.A and Ikpeze,
262 O.O. (2011) A Survey of Public Health Disease vectors Breeding in Refuse Dumps

263
264
265

in Onitsha Metropolis, Anambra State Nigeria. *New York Science Journal*: 4(9): 34-39.

UNDER PEER REVIEW