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Original Article

Species Composition and Abundance of Animals at Active Solid Waste Dumpsites in Minna Metropolis, Niger State, Nigeria

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ABSTRACT

City dumpsites are widely regarded as environmental hazards, yet they function simultaneously as artificial ecological niches that support diverse faunal communities. This study documented the species composition and abundance of animals associated with two active solid waste dumpsites, Unguwan Daji (U. Daji) and Kpakungu (Kpkg) with a garden located in a relatively undisturbed area serving as control (Ctrl) site in Minna Metropolis, Niger State, Nigeria. Field observation and participatory appraisal were conducted once monthly over four consecutive months (May to August 2025). A total of 598 individual organisms belonging to 41 species from six taxonomic classes were recorded: Insecta, Aves, Mammalia, Reptilia, Clitellata and Gastropoda. Insecta was the most dominant class (60.54%), followed by Mammalia (17.73%) and Aves (14.05%). The control site recorded the highest individual abundance (383), followed by Kpkg (130) and U. Daji (85). Faunal abundance differed significantly among the sampling sites ($\chi^2 = 195.65$, df = 10, $p < 0.001$). Prominent species included *Paratrechina longicornis* (15.36%), *Musca domestica* (9.02%), *Myrmeleon spp.* (9.02%), *Gallus gallus domesticus* (3.84%) and *Rattus rattus* (4.01%). The dominance pattern followed Insecta > Mammalia > Aves > Reptilia > Clitellata > Gastropoda across all sites. Site-specific differences in species composition reflected variations in waste content, habitat structure and disturbance levels. The presence of disease vectors and domestic animals at both dumpsite and control locations emphasised the public health risks associated with open dumping in residential settings. These findings provide baseline faunal record for active dumpsites in Nigeria's Guinea Savanna ecological zone with implications for integrated waste management and urban ecological monitoring.

Keywords: Animal diversity; urban ecology; solid waste; Guinea Savanna; faunal inventory; dumpsite

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INTRODUCTION

Rapid urbanization and population growth have significantly increased the volume of solid waste generated across cities in developing countries, and Nigeria is no exception [1, 2]. In many Nigerian cities, inadequate waste management infrastructure and weak regulatory enforcement have resulted in the proliferation of open dumpsites as the primary mode of solid waste disposal [3]. These sites, while regarded primarily as environmental and public health hazards, create distinct ecological conditions that attract and support diverse communities of animals [4, 5].

City dumpsites are characterised by continuous inputs of organic and inorganic waste materials, which provide sustained food resources, shelter and breeding substrates for a wide range of fauna [6]. Studies conducted in various global settings have documented the presence of rodents, scavenging birds, insects, reptiles and domestic animals at waste disposal sites, emphasising the ecological and epidemiological significance of these assemblages [5]. In Nigeria, Onen and Bassey [4] documented 40 animal species across three dumpsites in Calabar Metropolis, Cross River State, demonstrating that city dumpsites in the tropical rainforest zone support structured faunal communities with distinct trophic relationships. Similarly, Oka *et al*. [6] revealed that urban dumpsites in Cross River State function as fragmented but functional ecosystems harbouring diverse biological communities.

Despite these contributions, existing faunal studies on Nigerian dumpsites remain limited, particularly within the Guinea Savanna ecological zone of Nigeria, where the study area is located. The city is experiencing rapid urban expansion, resulting in increasing volumes of solid waste alongside persistent challenges in waste infrastructure and management which influence the composition of faunal assemblage [7, 8].

Furthermore, previous Nigerian dumpsite faunal studies have rarely incorporated formal control sites for comparison, thereby limiting the ability to distinguish dumpsite-specific faunal patterns from broader urban ecological conditions. This study addresses such by providing a documented account of animal species composition and abundance at active dumpsites, incorporating a control site for ecological comparison. The findings are expected to contribute baseline ecological data for urban wildlife monitoring and to inform waste management strategies through an improved understanding of the ecological dynamics associated with urban dumpsite

MATERIALS AND METHODS

Study Area

Minna Metropolis, the capital of Niger State, is located between latitudes 9°36'N and 9°61'N and longitudes 6°33'E and 6°55'E in Nigeria's middle belt (Fig. 1). The city spans two Local Government Areas, Chanchaga and Bosso. It has an estimated population of approximately 506,113 with a density of about 3,448 persons per km^2 [9]. The climate is classified as Guinea Savanna, characterised by a distinct wet season (May–October) and a dry season (November–April) with Harmattan winds (December–February) that reduce relative humidity to as low as 13%. Annual rainfall averages 2,200 mm and temperatures range from 26°C in January to 40°C in April [8, 10].

Two major active dumpsites were selected based on recommendations from the Niger State Environmental Protection Agency (NISEPA), on the basis of the diverse composition of solid wastes observed at each location [8]. The selected sites were:

Unguwan Daji (U. Daji) dumpsite: located at latitude 9.628853° and longitude 6.550988° opposite the Minna Eid ground, Abayi Road Minna. The primary land surrounding the site includes vegetation, agricultural areas, shrubs and scanty trees. Waste composition is predominantly domestic, comprising plastics, glass, rags and organic refuse [11].

Kpakungu (Kpkg) dumpsite: situated at latitude 9.601237° and a longitude of 6.550988° under the bridge along Baganakwo–Bosso Road Minna. This site serves a predominantly low-income residential area and receives a mix of domestic organic waste, plastics and other non-biodegradable materials [12].

A control (Ctrl) site: A garden located in a relatively undisturbed area was selected as a reference site for comparison with the dumpsite environment, following the procedures adopted by Zandybay *et al.* [13].

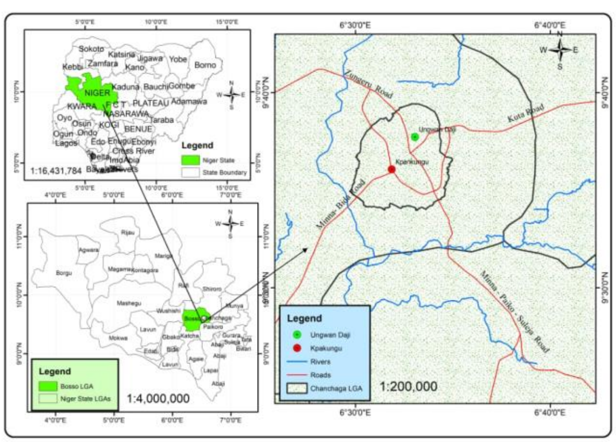

Figure 1: Diagram of Minna Metropolis, showing the suggested sampling location.

Data Collection

Animal species were documented using field observation as the primary method, complemented by participatory appraisal, following the protocols established by Oka *et al.* [6] and Onen and Bassey [4]. Field observations were conducted between 7:00 a.m. and 11:00 a.m. (Nigerian time), corresponding to peak animal activity and optimal visibility conditions. Walking transects were conducted across each site, during which vertebrate and invertebrate fauna, including birds, reptiles, mammals, insects and annelids were identified visually using standard taxonomic keys and field guides [14]. Smaller organisms such as arthropods were observed at ground level with the aid of hand lenses. Surveys were conducted once monthly over four consecutive months (May to August 2025).

Participatory appraisal was employed as a complementary qualitative approach to capture nocturnal, cryptic and organisms under concealed conditions not readily detected during standard field hours (Onen and Bassey [4]). Local residents, waste pickers and community members living in proximity to the dumpsites were engaged through structured interviews and informal interactions, providing firsthand accounts of species presence, feeding habits and seasonal occurrences [6]. Information obtained through participatory appraisal was cross verified with field data to ensure reliability [5].

Species Identification

Animal species were identified in the field using morphological characteristics including body size, coloration, body patterns and observable behavioural traits, following standard taxonomic keys [14]. Birds were identified using the Time-

Species Count method and verified against regional avifaunal checklists [15]. Mammals were verified using the Mammal Species of the World reference [16] and cross-checked with the Mammal Diversity Database [17]. For smaller or difficult-to-identify organisms, photographs were taken in situ and examined by specialists.

Data Analysis

Data was summarized using descriptive statistics. Frequency counts and percentages were employed to characterise the composition and relative abundance of animal species across the three study sites. Abundance data were computed as total individual counts per species, per class and per site. The percentage contribution of each taxonomic class to total abundance was calculated. Results are presented in tabular form. A Chi-square test of independence ($\alpha = 0.05$) was used to determine whether faunal abundance differed significantly across sampling sites and taxonomic classes.

RESULTS

A total of 598 individual organisms belonging to 41 species from six taxonomic classes were recorded. Table 1 presented a summary of species richness, total abundance and site-specific distribution by class.

Table 1. Species richness and abundance by taxonomic class at selected dumpsites in Minna Metropolis.

Class	No. of Species	Individuals (n)	U. Daji	Ctrl	Kpkg	% of Total
Insecta	12	362	30	296	36	60.54
Aves	14	84	13	25	46	14.05
Mammalia	9	106	28	30	48	17.73
Reptilia	4	35	9	26	0	5.85
Clitellata	1	8	5	3	0	1.34
Gastropoda	1	3	0	3	0	0.50
Total	**41**	**598**	**85**	**383**	**130**	**100**

U. Daji = Unguwan Daji; Kpkg = Kpakungu; Ctrl = Control site. $\chi^2 = 195.65$, $df = 10$, $p < 0.001$.

The control site recorded the highest individual abundance (383; 64.05% of all individuals), followed by Kpkg (130; 21.74%) and U. Daji (85; 14.21%). The overall dominance pattern across all sites followed: Insecta > Mammalia > Aves > Reptilia > Clitellata > Gastropoda.

Chi-square analysis revealed a significant overall difference in animal abundance among the sampling locations and taxonomic classes ($\chi^2 = 195.65$, df = 10, $p < 0.001$).

Distribution and Relative Abundance of Individual Species at the Selected Dumpsites in Minna Metropolis

Table 2 presented the full species list, taxonomic classification and site-specific abundance across U. Daji, Ctrl and Kpkg, along with the percentage contribution of each species to total recorded individuals.

Table 2. Composition and abundance of animal species recorded at selected dumpsites and control site in Minna Metropolis.

Common Name	Species	Class	U. Daji	Ctrl	Kpkg	Total	Pecentage (%)
Snail	*Achatina achatina*	Gastropoda	0	3	0	3	0.50
Mosquito	*Aedes aegypti*	Insecta	0	12	16	28	4.68
Lizard	*Agama agama*	Reptilia	6	15	0	21	3.51
Honey bee	*Apis mellifera scutellata*	Insecta	0	31	0	31	5.18
Dragonfly	*Aisoptera sp.*	Insecta	1	14	2	17	2.84
Bush brown butterfly	*Bicyclus safitza*	Insecta	0	2	0	2	0.33
Cow	*Bos taurus*	Mammalia	0	1	13	14	2.34
Dog	*Canis familiaris*	Mammalia	4	0	6	10	1.67
Goat	*Capra hircus*	Mammalia	9	5	5	19	3.18
Speckled pigeon	*Columba guinea*	Aves	0	2	0	2	0.33
Pigeon	*Columba livia*	Aves	0	0	18	18	3.01
Giant pouched rat	*Cricetomys gambianus*	Mammalia	0	3	0	3	0.50
African monarch	*Danaus chrysippus*	Insecta	4	2	3	9	1.51
Straw-coloured fruit bat	*Eidolon helvum*	Mammalia	0	14	0	14	2.34
Grass yellow butterfly	*Eurema hecabe*	Insecta	4	1	0	5	0.84
Horse	*Equus ferus caballus*	Mammalia	0	0	2	2	0.33
Lanner falcon	*Falco biarmicus*	Aves	1	0	0	1	0.17
Redneck falcon	*Falco chicquera*	Aves	1	0	0	1	0.17
Cat	*Felis catus*	Mammalia	5	1	7	13	2.17
Domestic hen	*Gallus gallus domesticus*	Aves	0	0	23	23	3.85
Barn swallow	*Hirundo rustica*	Aves	0	0	5	5	0.84
Long-tailed glossy starling	*Lamprotornis caudatus*	Aves	3	0	0	3	0.50
Earthworm	*Lumbricus terrestris*	Clitellata	5	3	0	8	1.34
Termite	*Macrotermes bellicosus*	Insecta	0	15	0	15	2.51
Housefly	*Musca domestica*	Insecta	18	24	12	54	9.03
Antlion	*Myrmeleon spp.*	Insecta	0	54	0	54	9.03
Blacknecked spitting cobra	*Naja nigricollis*	Reptilia	2	1	0	3	0.50
Weaver ant	*Oecophylla longinoda*	Insecta	0	48	0	48	8.03
Sheep	*Ovis aries*	Mammalia	3	0	4	7	1.17
Black crazy ant	*Paratrechina longicornis*	Insecta	0	92	0	92	15.38
Northern grey-headed sparrow	*Passer griseus*	Aves	2	0	0	2	0.33
Cabbage butterfly	*Pieris brassicae*	Insecta	3	1	3	7	1.17
Village weaver	*Ploceus cucullatus*	Aves	0	5	0	5	0.84
Common bulbul	*Pycnonotus barbatus*	Aves	2	7	0	9	1.51
Rat	*Rattus rattus*	Mammalia	7	6	11	24	4.01
Laughing dove	*Spilopelia senegalensis*	Aves	1	5	0	6	1.00
Ring-necked dove	*Streptopelia capicola*	Aves	0	2	0	2	0.33
Skink lizard	*Trachylepis quinquetaeniata*	Reptilia	1	8	0	9	1.51
African thrush	*Turdus pelios*	Aves	3	2	0	5	0.84
Barn owl	*Tyto alba*	Aves	0	2	0	2	0.33
Monitor lizard	*Varanus exanthematicus*	Reptilia	0	2	0	2	0.33
Grand Total			**85**	**383**	**130**	**598**	**100**

U. Daji = Unguwan Daji; Kpkg = Kpakungu; Ctrl = Control site.

Insecta was the most dominant class, contributing 60.54% of all recorded individuals. The class was represented by 12 species, with *Paratrechina longicornis* (black crazy ant) recording the highest individual count (92; 15.38%), followed by *Myrmeleon spp.* (antlion; 54; 9.03%), *Musca domestica* (housefly; 54; 9.03%), *Oecophylla longinoda* (weaver ant; 48; 8.03%) and *Apis mellifera scutellata* (honeybee; 31; 5.18%). *Aedes aegypti* (mosquito; 28; 4.68%) and *Macrotermes* *bellicosus* (termite; 15; 2.51%) were also recorded. The control site recorded the highest insect abundance, particularly dominated by *Paratrechina longicornis* (92 individuals), *Myrmeleon spp.* (54) and *Oecophylla longinoda* (48), all exclusively recorded at the Ctrl. Dumpsites supported notable insect populations, primarily *Musca domestica* at U. Daji (18) and *Aedes aegypti* at Kpkg.

Birds constituted the third most abundant class (14.05%; 84 individuals) and the highest in species richness with 14 species recorded. *Gallus gallus domesticus* (domestic hen) was the most abundant bird species overall (23; 3.85%), recorded exclusively at Kpkg. *Columba livia* (pigeon; 18; 3.01%) was also exclusively recorded at Kpkg. *Pycnonotus barbatus* (common bulbul; 9; 1.51%), *Ploceus cucullatus* (village weaver; 5; 0.84%) and *Spilopelia senegalensis* (laughing dove; 6; 1.00%) were predominantly recorded at the control site. U. Daji recorded *Lamprotornis caudatus* (long-tailed glossy starling; 3; 0.50%) and both *Falco biarmicus* and *Falco chicquera* (1 each; 0.17%). *Hirundo rustica* (barn swallow; 5; 0.84%) was exclusively recorded at Kpkg. *Tyto alba* (barn owl; 2) was recorded only at the Ctrl.

Mammals accounted for 17.73% of total individuals (106 individuals) across 9 species. *Rattus rattus* (rat) was the most widely distributed mammalian species, recorded across all three sites (U. Daji: 7, Ctrl: 6, Kpkg: 11; total 24; 4.01%). *Capra hircus* (goat; 19; 3.18%) was recorded at all three sites, while *Bos taurus* (cow; 14; 2.34%) was predominantly at Kpkg (13 of 14). *Eidolon helvum* (straw-coloured fruit bat; 14; 2.34%) was exclusively at the Ctrl. *Felis catus* (cat; 13; 2.17%) was recorded at all sites, with highest abundance at Kpkg (7). *Canis familiaris* (dog; 10; 1.67%) was present at U. Daji and Kpkg. *Cricetomys gambianus* (giant pouched rat; 3; 0.50%) was recorded only at the Ctrl.

Reptiles contributed 5.85% of total individuals (35 individuals) across 4 species. *Agama agama* (common lizard; 21; 3.51%) was the most abundant reptile, recorded at U. Daji (6) and the Ctrl (15) but absent from Kpkg. *Trachylepis quinquetaeniata* (skink lizard; 9; 1.51%) was predominantly at the Ctrl (8). *Naja nigricollis* (blacknecked spitting cobra; 3; 0.50%) was recorded at U. Daji (2) and Ctrl (1). *Varanus exanthematicus* (monitor lizard; 2; 0.33%) was exclusively at the Ctrl.

Clitellata was represented by a single species, *Lumbricus terrestris* (earthworm), with 8 individuals recorded (1.34%), distributed across U. Daji (5) and Ctrl (3) only, with complete absence from Kpkg. Gastropoda was equally represented by a single species, *Achatina achatina* (giant African snail), with only 3 individuals (0.50%), all exclusively recorded at the Ctrl site and absent from both dumpsites.

DISCUSSION

The documentation of forty-one (41) animal species from six taxonomic classes at active dumpsites and a control site comfirmed that urban waste environments in Nigeria's Guinea Savanna zone support a diverse range of fauna. The findings were consistent with observations from other Nigerian urban settings. Onen and Bassey [4] recorded 40 animal species from three dumpsites in Calabar, Cross River State, while the global review by Sangkachai et al. [5], covering 345 studies across 69 countries, identified nearly 400 terrestrial and insect species associated with garbage dumps worldwide.

The higher abundance at the Ctrl in the present study is attributable to more stable microhabitat conditions, including undisturbed vegetation, consistent moisture, absence of heavy metal toxicity and lower anthropogenic disturbances which collectively favour a broader range of organisms [5, 6]. This finding indicated that in the Guinea Savanna context, habitat stability and ecological complexity may outweigh food resource availability as determinants of overall faunal abundance at dumpsites.

Site-specific differences in species composition between U. Daji and Kpkg further reflected variations in waste content, catchment population and surrounding land use. Kpkg recorded higher abundances of large domestic mammals (*Bos taurus*, *Gallus gallus domesticus*, *Columba livia*), consistent with its location in a lower-income residential where livestock interact freely with waste sites [12]. U. Daji, by contrast, recorded higher proportions of Insecta relative to other classes, particularly *Musca domestica*, indicating that the domestic waste composition at that site is rich in organic refuse which is particularly conducive to fly breeding and feeding [5].

The dominance of Insecta at 60.54% of all recorded individuals is a significant finding with ecological and public health implications. Insects represent the primary entry point of organic matter into the food web, driving decomposition and nutrient cycling at both dumpsites and the control site [18]. The high abundance of social insects such as *Paratrechina longicornis*, *Oecophylla longinoda* and *Macrotermes bellicosus* at the control site particularly reflects the role of stable soil conditions and vegetation in sustaining insect colony structures [5]. The presence of *Musca domestica* (housefly) across all three sites and *Aedes aegypti* (mosquito) at both Kpkg and the Ctrl site is of direct concern. *Musca domestica* is a well-documented mechanical vector of enteric pathogens including *Salmonella spp.* and *Shigella spp.* [5], while *Aedes aegypti* is the primary vector of dengue fever and yellow fever. Their co-occurrence at dumpsites and the control site indicated that dumpsite-associated insect vectors are not confined to the waste area itself but extend into adjacent residential environments [18,5]. This is consistent with the health impact sphere concept applied by Onen and Bassey [4] which emphasised the public health risk posed by open dumping in residential settings.

Birds are widely recognised as environmental indicators, responding sensitively to changes in habitat quality and food availability [19, 15]. The distribution of bird species between dumpsites and the control site in this study reflected differences in ecological function. Kpkg attracted predominantly synanthropic and commensal species (*Gallus gallus domesticus*, *Columba livia*, *Hirundo rustica*) that exploit food waste as a primary resource, while the control site supported a more ecologically diverse assemblage including *Pycnonotus barbatus*, *Spilopelia senegalensis*, *Tyto alba* and *Ploceus cucullatus*, which depend on vegetated habitats for foraging, nesting and roosting [6,15]. The exclusive occurrence of the raptors *Falco biarmicus* and *Falco chicquera* at U. Daji revealed the presence of suitable prey organisms, particularly small vertebrates such as rodents and lizards, within the site. Their presence indicated that the dumpsite supported higher trophic interactions, thereby lending support to the assertion by Oka et al. [6] that dumpsites, despite their disturbed nature, can sustain multi-trophic faunal assemblage's characteristic of functioning artificial ecosystems.

The mammalian assemblage documented in this study included both wild and domestic species, indicating a combination with direct implications for zoonotic disease transmission [5]. *Rattus rattus* was the most widely distributed species across all three sites. This observation was consistent with the global literature rodents as the dominant mammalian order in dumpsite environments [20, 5]. Rodents serve as reservoir hosts for a range of zoonotic pathogens including *Leptospira spp.* and *Toxoplasma gondi* [20]. Their presence across both dumpsites and the control site indicated that contamination pathways are not restricted to the dumpsite boundaries [20].

Cricetomys gambianus (giant pouched rat), recorded exclusively at the control site in this study, was flagged as a threatened species in Calabar by both Oka et al. [6] and Onen and Bassey [4], where it was known locally as 'Okon Calabar'. The low occurrence of this species in the present study confined to the less-disturbed control site suggested that the intense disturbance levels at the active dumpsites might limit its habitat use, even as it exploits the broader urban landscape [4].

The domestic and semi-domestic animals such as *Capra hircus*, *Bos taurus* and *Canis familiaris* that move freely between waste disposal sites and human habitation, showned thier functions as biological bridges that facilitate pathogen transfer between the dumpsite environment and surrounding households [5, 4].

The comparatively low abundance of Reptilia (5.85%), Clitellata (1.34%) and Gastropoda (0.50%), with the latter two groups partially or entirely absent from the dumpsite locations, is ecologically informative. These groups are sensitive to soil disturbance, moisture fluctuation and chemical contamination, making their restricted distribution as indirect indicator of dumpsite-associated habitat stress [21]. The complete absence of *Achatina achatina* from both dumpsites and its restriction to the Ctrl site is particularly consistent with findings by Oka et al. [6], who noted that land snails prefer stable, humid and less polluted habitats. The absence of *Lumbricus terrestris* from Kpkg, despite its presence at U. Daji and the Ctrl, might reflect site-specific differences in soil moisture and organic matter content.

CONCLUSION

The study provides baseline data on animal species composition and abundance at active solid waste dumpsites in Minna Metropolis within Nigeria's Guinea Savanna zone. A total of 598 individuals representing 41 species across six taxonomic classes were recorded, with Insecta, Mammalia and Aves as the dominant groups. Faunal abundance varied significantly across sampling sites and taxonomic classes, indicating the influence of environmental conditions on species distribution. The occurrence of disease vectors, domestic animals and wildlife across dumpsite and control sites emphasised the public health implications of open dumping in residential areas. The findings stressed the need for integrated waste management strategies that consider both environmental and public health impacts of faunal communities associated with urban waste sites.

Authors' Contributions

AZA conceptualized and designed the study. AZA participated in fieldwork and data collection, performed the data analysis, interpreted the findings together with AAV and prepared the first draft of the manuscript. The manuscript was reviewed by AAV and CVI. All authors contributed to the development of the final manuscript and approved its submission.

Conflict of Interest

The authors declare no conflict of interest.

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