

BAT ROOSTS AND ASSOCIATED NUISANCE IN PUBLIC PRIMARY AND SECONDARY SCHOOLS IN ZARIA, NIGERIA: A PROBLEM WORTH ADDRESSING

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ABSTRACT

A Survey was conducted to establish bat roosts in public primary and secondary schools and the nature of nuisances they constitute to effective teaching and learning process in Zaria. The entire public pre-tertiary school structures within Zaria metropolis were examined for bat roost by internal and external inspections. Concerns on the presence of roosting bats were sought through questionnaire given to 384 school children and Heads of schools occupied by bats were interviewed. The survey revealed that, of the total 75 schools located within the metropolis, 21 (28%) had roosting bats. All the schools with colony of roosting bats were plagued with bat nuisances such as distracting noise, stains, damaged ceilings, droppings and odour that threaten the health, safety and learning conditions of school children. Although most of the school children (70.7%) feel tense on seeing bat, 52.7% were however uncertain as to whether presence of bats could affect their academic performance or not. Heads of schools (43%) reported great concern on health and safety issues. Collaboration between school managements and local wildlife ecologists was recommended to address these nuisances.

Keywords: Bat roost, nuisance, pre-tertiary school, Zaria

1. INTRODUCTION

Bat roost is a place where bats settle or congregate to rest in the day or night. The abundance of bat populations could depend on the availability of suitable roosting sites (Usman, 2010). In Zaria, bats natural roosting sites appear to be declining in numbers, presumably due to urbanization resulting in change in their natural habitat. The hitherto biggest colony and abode of bats which used to be the Zaria Railways Quarters, Anguwan Iya (Usman, 2010), some parts of GRA area and Kofan Gayan Low-cost Quarters (Sadauki, pers.com. 2015) witnessed massive felling of trees and renovation or construction of buildings which has decimated the bat populations, hence increasing bats dependence on man-made structures that meet their thermoregulation and security needs. Considering their nature in terms of level of human disturbances and availability of accessible large roof voids with unobstructed flying spaces, public primary and secondary schools offer a range of possible roosting opportunities for bats. Presence of active bats within urbanised environment can have several economic and aesthetic benefits (Bat Conservation Trust (BCT), 2014). However, given the wrong set of circumstances, bat species can become a nuisance. Besides being providers of many ecosystem services such as control of insect populations, pollination, and seed dispersal (Kelly, 2012), bats are often unwanted visitors in the urban landscape. Aside their destructive roosting activities, they are mostly regarded as causative agent of perilous diseases. Funmilayo (1976) and Ayoade *et al.* (2012) reported that bats (*Eidolon helvum*) threaten plant species when

they turn treetops and trunks to their place of abode, causing loss and premature shedding of leaves and hence the death of some of such host trees. Bats diminished the ability of trees to provide canopy and serve as wind barrier (Ayoade *et al.*, 2012). Koski (2014) reported three types of nuisances bats can do in human dwellings; Spread of disease, introduction of mites and structural damage. Conversely, Gore and Studenroth (2005) found that bats roosting in urban landscape pose little threat to humans, as long as the bats are not directly contacted. Moreso, sixty-six (66) viruses have been isolated from bats (Calisher *et al.*, 2006). These among others provide challenges to bat populations persistence in human dominated areas. Despite the apparent high occupancy rate of bats in human dwellings, previous studies mostly focus on bat taxonomy, ecology (Okon 1974; Funmilayo, 1979; Hill *et al.*, 1988; Angelici *et al.*, 2000), and damages they cause to trees in a landscape (Funmilayo, 1976; Ayoade *et al.*, 2012). This study therefore provides quantitative information about bat roosts and the associated nuisance issues in public pre-tertiary schools in Zaria.

2. METHODOLOGY

2.1 Study area

The study was conducted in Zaria Local Government Area, Kaduna State. Zaria lies in the northern Guinea Savanna zone of Nigeria, between latitude 11°15'N and 11°3'N of the equator and longitude 7°30'E and 7°45'E of the Greenwich meridian (Idowu, 2010). Rainy season is between May to September, and dry season is between October to April with mean daily temperature of 27°C (Idowu, 2010). Zaria is characterized by mainly open woodland vegetation (Hore, 1970). It has a projected human population of 472,860 in 2011 (NPC, 2006).

2.2 Ethical clearance

Approval to conduct the research was obtained from Zaria Local Education Authorities. Principals, Headmasters and teachers of the surveyed schools were briefed prior to the survey.

2.3 Bat roosts in schools and associated nuisances

The entire public primary and secondary school buildings within Zaria metropolis were inspected internally and externally during daylight hours, using binocular and ladder when required as the case may be, to search for evidence of roosting bats using BCT (2007) guidelines. The schools were also walked to establish other possible roosting sites within the school vicinity such as on trees (Hudt, 2012). School was recorded as occupied provided one or more signs were observed as they indicate regular use by bats (Jeffery and Karl, 2005). A 13 megapixel digital camera was used to take photographs at each confirmed sites to showcase the observed nuisance/damage associated with roosting bats.

Using Krejcie and Morgan (1970) table of sample size determination, 384 school children from both primary and secondary schools with roosting bats were randomly sampled and were administered with questionnaire to appraise their opinion about roosting bats in their respective schools. The Head of schools were interviewed on their concerns and mitigation strategies.

2.4 Dusk emergence observations

Dusk emergence observations were conducted in schools with evidence(s) of bat presence. Emergence counts commenced 30 minutes before the sunset until one and the half minutes after sunset (Hudt, 2012). This was conducted three times in each established roost as recommended by BCT (2007). The counts were done using Hand-counter (Razafindrakoto *et al.*, 2010) and camera

(BCT, 2007). Field Assistants were employed due to complexity of some schools. Emergence counts were rescheduled in cases of inclement weather (Ford *et al.*, 2005; Threlfall *et al.*, 2011). No attempt was made to capture bats for identification, however dead bats discovered on the floors during the survey were identified using Happold, (1987).

3. RESULTS

The survey revealed that of the 51 primary schools surveyed, 9 (18%) had bat roosts while 12 (50%) of the 24 secondary schools had bat roosts. The total bats occupancy in public primary and secondary schools within Zaria metropolis is 28% (21). The roosts were located across all the 7 educational districts (Table 1). Bats guano (faecal waste), urine stains, bats odour, live bats, noises produce by bats from their hideouts and bat carcasses were field signs discovered during day light survey to establish bats presence in the visited schools. *Eidolon helvum* (African straw-coloured fruit-bats), *Epomophorus gambianus* and *Rhinopoma* spp. (Mouse-tailed bat) were identified through their carcasses accidentally found on the ground during the survey. Table 2 showed the highest counts of emerging microchiropterans (*Rhinopoma* spp) and megachiropterans (*E. helvum*) made in Adamu Dikko Primary School (153+) and Waziri Lawal Township Primary School (322+) respectively. The least emergence count was made in Government Girls Secondary Dogon Bauchi (7 Microchiropterans). Bats were observed to make use of multiple exit points in most schools while emerging from their roosts. No bat was found to emerge from three schools with bat use evidence. The average emergence time recorded was 20 minutes after sunset (Table2). Microchiropterans roosted specifically inside ceilings while megachiropterans on highly branched mango trees.

Schools with bat colony were found to encounter different kinds of nuisance caused by roosting activities of bats which are very difficult to quantify but characterised. All schools identified with bat roosts had either multiple pellets of moist, soft guano indicating it was fresh, or dried guano. These are stuck to a wall by cobwebs under identifiable holes, in pile under a damaged ceiling, sprinkled over school items or accumulate inside ceilings over time, or continuously drop inside active and abandoned school buildings (Plate 1a and b). Bats guano deposits mixed with their urine or rain water overtime were found in some schools to have soaked, stained and damaged the area of the ceiling affected accompanied with distinctive musty, acrid pungent odour (Plate 1c). Bats in some schools were also been found to have taken over some classroom and school buildings such as library by their roosting activities. They also render some classroom non-conducive for teaching and learning activities (Plate 1c, e and f). Cases of live and freshly dead bats were discovered on the ground within school vicinity (Plate 2a, b and c). In all the school with roosting bats; no wall, roof or rafter damages were noticed to be associated with bats. No nuisance issues were discovered in schools with solitary bats.

Table 1: Number (%) of pre-tertiary schools occupied by roosting bats in Zaria

Districts	Primary Schools		Secondary Schools		Total Occupied
	Surveyed	Occupied	Surveyed	Surveyed	
Pada	14	1	7	3	21
Kaura	11	2	3	1	14

Rafin	10	1	1	0	11	1 (9.0)
Albasa						
Ung.	5	1	2	2	7	3 (43)
Dankali						
Tudun	8	3	4	2	12	5 (42)
Wada						
Dambo	3	1	1	1	4	2 (50)
Sabon Gari	-	-	6	3	6	3 (50)
Total	51	9 (18)	24	12 (50)	75	
21 (28)						

Table 2: Estimated population size and mean emergence time of bats in pre-tertiary schools in Zaria

Schools (Roost sites)	Maximum count of emerging bats	Number of exits	Mean emergence time (minutes)
Ahamdu Fatika P.S	63*	Multiple	15.7±
Adamu Dikko P.S	153+*	Multiple	17.8±
Haruna Soba P.S	118+*	Multiple	21.7±
Sani Adamu P.S	109+	Multiple	19.3±
Nuhu Baturen Makaratn P.S	7*	Single	12.8±
LT. Col. M. Jumare P.S	-	-	-
Waziri Lawal Township P.S	73*, 322+**	Multiple	31.0±
Ahmadu Gyallesu P.S	115+*	Multiple	21.0±
Isan Nabawa P.S	16*	Single	10.7±
Barewa College Zaria	31*	Multiple	21.0±
Commercial College Zaria	124+*	Multiple	22.0±
Science School Kufena	22*	Multiple	13.0±
Govt. Girls Sec. Sch. Dogon Bauchi	6*	Single	12.7±
Govt. Sec. Sch. Chindit Barrack	103+*	Multiple	21.7±
Alhuhuda College Zaria	77+*	Multiple	22.7±
Govt. Girls Sec. Sch. K/Gayan	58*, 31+**	Multiple	26.0±
Govt. Sec. Sch. Kofan Jatau	-	-	-
Govt. Sec. Sch. Zaria	121+*	Multiple	27.0±
Govt. Sec. Sch. Tudun Jukun	-	-	-
Govt. Girls Sec. Sch. Zaria	52*, 38**	Multiple	29.0±
Govt. Sec. Sch. Dakace	13*	Multiple	16.0±
			20mins

Keys: P.S = Primary school, Govt. Sec. Sch. = Government Secondary School,
 * = microchiropterans, ** = megachiropterans,
 + = suspected to be more than the maximum count



Plate 1(a-f): Bat roost related nuisances observed in some public school surveyed



Plate 2 (a-c): Instances of dead and live bats, an indication of bats-school children closeness in some of the surveyed schools

Out of the 384 questionnaire administered to school children, 376 (97.9%) were returned and filled. Figure 1 showed that slightly more than half (53.0% boys) and less than half (31.0% girls) were aware that bats are actually roosting in their schools. On the risks and perceived risk of getting in contact with bats, only less than 1% (boys) admitted to have killed a bat before, see a grounded bat (44.0% boys, 19.0% girls), touched a bat (7.6% boys, 1.4% girls), and none (0.0%) of the respondents agreed to have ever been scratched or bitten by a bat before (Figure 1). Majority (61.0%) of the girl respondents in contrast with 14.4% of boys believed that there is likelihood for a bat to land on them. Tables 3 showed that, more than two-third (77.9%) of the respondents regarded bats as nuisance animals, (88.1%) disease vectors, (70.7%) feel tense on seeing bat, as such, (68.9%) don't like bats in their schools. However, slightly above half (52.7%) of the respondents were indecisive as to whether presence of bats in or outside their classrooms could affect their academic performance. The Heads of schools with bat roosts interviewed lamented that the presence of bats was of a great concern.

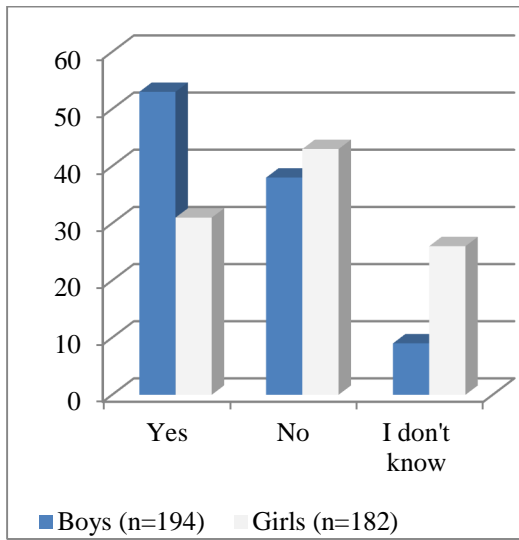


Figure 1: School children awareness of roosting bats in their schools

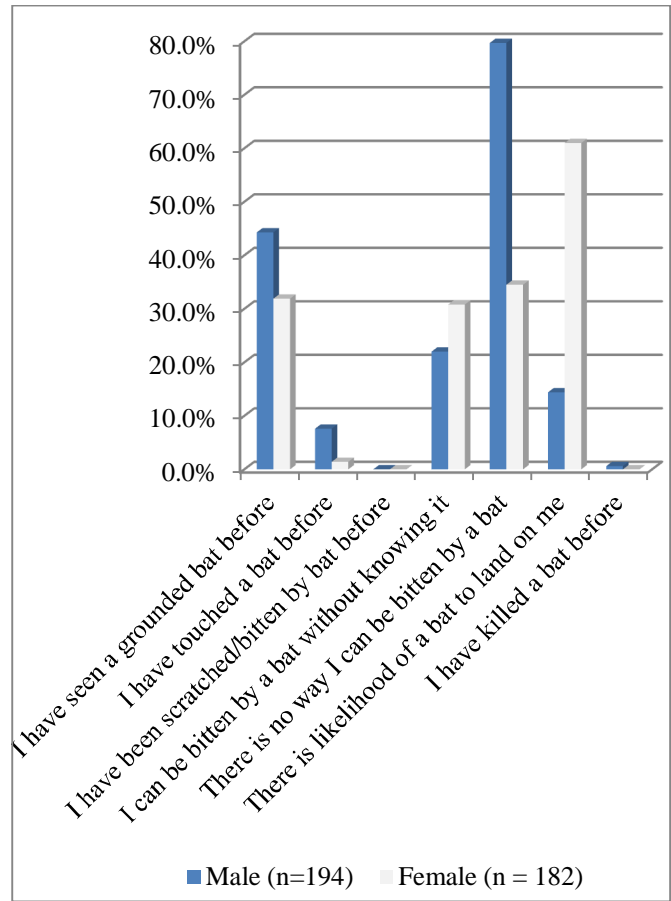


Figure 2: Risks and perceived risks of school children on the presence of bats in their schools

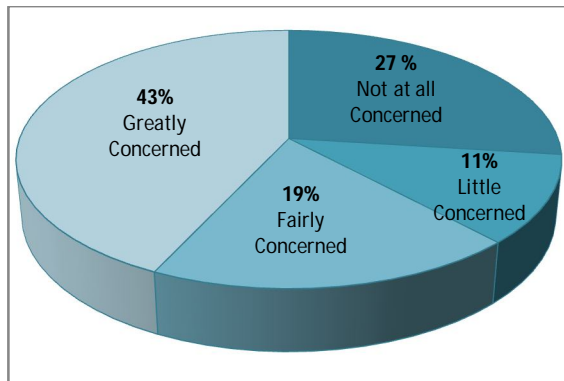


Figure 3: School Heads concern about the roosting bats in their schools

Table 3: School children beliefs about roosting bats in their schools

Items	Frequency (Percentage)				
	Strongly Agreed	Agreed	Uncertain	Disagreed	Strongly disagreed
I do not like having bats in my school	143 (38.0)	116 (30.9)	17 (4.5)	87 (23.1)	13 (3.5)
Bats are nuisance animals	97 (25.8)	167 (44.4)	34 (9.0)	24 (6.4)	54 (14.4)
I lose concentration knowing bat is closed to me	87 (23.1)	53 (14.1)	181 (48.1)	18 (4.8)	37 (9.8)
If I see a bat I feel tense	173 (46.0)	93 (24.7)	56 (14.9)	33 (8.8)	21 (5.6)
Bats can spread diseases	254 (67.6)	77 (20.5)	18 (4.8)	12 (3.2)	15 (3.9)
Bats can attack people	119 (31.6)	104 (27.7)	89 (23.7)	34 (9.0)	30 (7.9)
Present of bats in my school could affect my academic performance	86 (22.9)	56 (14.9)	198 (52.7)	23 (6.1)	13 (3.5)

The most commonly reported concerns by Heads of schools were on health and safety issues (52.4%), followed by interference with teaching and learning process (38.1). When asked about the action they were taking against roosting bats, most of the School Heads reported not taking any proactive measure. Those that took measure either completely remove or tatter the ceiling of classroom with bats or apply different brands of lethal chemicals as deterrent mitigation against the roosting bats. Both the actions were also reported to be only temporary successful hence not effective.

Table 4: Reasons for wishing to be rid of roosting bats by Heads of schools

Reasons	Number of schools (%)
Fear of increase in bat populations	3 (14.3)
Noise they produce during the day	4 (19.0)
Health and safety issues	11 (52.4)
General fear of bats	4 (19.0)
Sanitation issues (bat odour, guano accumulation and urinary matter)	7 (33.3)
Property damage (e.g. deterioration of ceilings, stored materials etc)	5 (23.8)
Dead, flying or crawling bats within the school	5 (23.8)
Interference with teaching and learning process	8 (38.1)
Cost of fixing or buying the spoilt items	6 (28.6)

4. DISCUSSION

Only *E. helvum*, *E. gambianus* and *Rhinopoma* spp. carcass were discovered and identified. The presence of carcasses of *E. helvum*, *E. gambianus* and *Rhinopoma* spp. could be that other bat species could also be roosting in and around school structures. According to IUCN, *E. gambianus* (Mickleburg *et al.*, 2008) and *Rhinopoma* spp. are listed as “Least Concern” as they are widespread with no current identifiable major risks (Anglanier and Palmeirim, 2008) while *Eidolon helvum* is listed as “Near Threatened” (Mickleburg *et al.*, 2008). In Zaria, these species are not hunted for meat but are considered to be pest species (Sadauki, pers.com. 2015). Almost all the schools they occupied were old and mostly not more than 2.5km away from the nearest water source, which indicates that residential buildings situated along water bodies could be under increase risk of

adoption by bat colonies if eventually evicted from schools. The schools with bats colony >50 were observed to show a greater evidence of bat use, suggesting that, they harbour maternity colony and roost fidelity while those with evidence of minor use may be used as either occasional day roosts or night roosts (Kunz and Reynold, 2003). The recorded emergence time of 20 minutes after sunset in this study was distinctively smaller when compared with 45 minutes after sunset reported by Jones and Rydell (1994). The variations of emergence could probably be attributed to level of human activities around the roost (Threlfall *et al.*, 2011), distance to foraging site or inclement weather (Ford *et al.*, 2005). The availability of multiple access points use by bats and the lack of effective mitigation approaches proves it difficult for school authorities to evict bats so easily and successfully.

The anecdotal records from Zaria Education Authorities revealed that no bat related bite or infections has ever been recorded in the division, which are also in line with school children responses. However, dead bats incidentally found within school environs during the surveys increases the closeness and chances of bats-school children contact. These pose a health risk to school children because of their greater propensity for putting hands in their mouths. Ademola (2012) reported school children in Zaria not hygienically sensitive in terms hand washing, especially before eating. More so, school children out of inquisitiveness or pity may want to explore or rescue fallen bat, thus maximizing the risk of being bitten by a bat.

Guano accumulating more frequently under weak or damage ceilings present a sanitation difficulty as in most schools school-children have to clean the regular faecal deposit on a daily basis. It also poses health risks to both school children and staff as bats guano is known to provide a growth medium for microorganisms, some of which are pathogenic. Calisher *et al.* (2006) reported *Histoplasma capsulatum* in bat guano which causes a lung disease called Histoplasmosis, a flu-like respiratory disease. The infectious spores in the guano can be inhale when aerosolised during sweeping. Allowing bats colonies to persist for years and guano deposits to accumulate to some extent bespeaks neglect and lukewarm attitudes towards school properties and children's health by school management. The situation is also aggravated by the fact that public pre-tertiary schools in the study area are poorly maintained structurally and the notion that bats nuisances are seasonal.

Teaching and learning activities in schools with bat colonies were found to be seriously affected in one way or the other by bats related nuisances. The situation ranges from fear on the side of teachers and school children in particular while the class activities are going on and non conducive classrooms environment. These result from the distracting noise produce by bats especially during sunny days, their offensive odour that permeates the entire classroom, irritating stained ceiling and scratching sound produced by bats from their hideouts. Roosting bats taking over classrooms and other important school buildings has limited the use of some school resources and has necessitated school authorities to combine school children of different classes into one class. These kinds of nuisances by roosting bats in human dwellings might have further augment the perceived negative image held by people toward bats (Fenton, 2003) and also present a conservation challenges to bats in urban landscape.

4.1. Implications for conservation

Of the 21 schools occupied by bats in the study area, none is deem secured as roost for bats in future as they can be renovated at anytime. Therefore, the way roosting bats are perceived by school management will greatly affect bat local populations within Zaria metropolis. If bats are merely perceived as harmful in school they occupied by overweighing their associated nuisances over their ecological roles, then school managements would lack any motivation to take specific actions especially during renovations or constructions that might favour bats by evicting them in a

humanely way. This calls for ecological intervention such as introduction of bat houses in schools or/and other effective environmentally sound mitigation strategies.

5. RECOMMENDATIONS

Simple repairs and maintenance should be carried out regularly in schools with bats damages to restored effective teaching and learning environment. If exclusion of bats from school building became necessary, it should be conducted using humane and environmentally sound methods. To avoid unjustifiable treatment of these bats and their local population dwindle, there is need for local conservationist involvement to address issues on how to prevent or manage bats related nuisances/health risks in schools that still harbour bats in Zaria.

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