

Effects of Urbanization and Agricultural Expansion on the Upsurge of Wild Rats (*Rattus rattus*) in Yenagoa Metropolis of Bayelsa State, Nigeria

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Abstract: In this study, the impact of habitat characteristics on the abundance and relative distribution of wild black rats (*Rattus rattus*) as influenced by human activities was investigated in Yenagoa and its environs in Bayelsa state of Nigeria. Consequently three ecological zones namely: 1.zone of stable urban centre, 2.zone of rapid urban transformation, and 3.zone of undisturbed rural centre were mapped out with three ecological subsets from each zone. These subsets include; site A-undisturbed landscape area, site B-stable human settlement area and site C-refuse dump site area. Standard trapping procedures were then adopted using bread and raw cassava as baits. A total of 1411 black rats were caught in 1002 trap nights representing a mean trap success of 46.9%. The relative abundance of rats caught were highest in zone 2 with 46.4% and lowest in zone 1 with 11.9%. An analysis of variance indicated that there was a significant difference in the abundance of rats in the various study zones ($F_{\text{ca}} = 1.626$, $MSE = 21168.11$, $p < 0.05$). A Post Hoc analysis also shows a significant difference on the influence of site structure on black rat population. It is therefore worthwhile to conclude that black rat can be used as bioindicator to monitor the ecosystem health in an environment of growing human population.

Key words: Ecosystem, rats, relative abundance, urbanization

INTRODUCTION

The recent upsurge in wild population of the black rat (*Rattus rattus*) in several parts of Bayelsa state is worrisome. This may not be unconnected with the agricultural expansion which often disrupts and fragment wild habitats, causing increased competitions over scarce resources and interaction with commensal rodents that migrate with expanding human-influenced habitats (John *et al.*, 2010). These migratory activities of black rats as a result of agriculture and urbanization will not only put the lives of humans at risk of contracting series of rat-related diseases (Udonsi, 1989), but also driving away the sylvatic species to local extinction and replacing them with invasive commensal rodents, thereby reducing biodiversity and ecological health (Joyce *et al.*, 2000). To this end, many scientist have studied the distribution of wild black rats (*Rattus rattus*) in diverse ecological settings globally. Gavareski (1976) investigated the distribution of wild black rats within urbanizing areas in Seattle, Washington. Aubry and Brookes (1991) also

studied the behaviour and distribution of wild black rats in unmanaged Douglas-fir forest in Portland in the United States of America. While in full grown primary forest under differing cutting practices and intensity of landscape and development in Washington was studied by Stofel (1993). But in Africa, the invasive attitude and distribution pattern of wild black rat which is known to be responsible for lasa fever had been studied in the eastern and northern parts of Nigeria under various ecological settings (Udonsi, 1989). However, there is paucity of information on the distribution of wild black rats in Bayelsa state to encourage planning.

Therefore, the objectives of this study is to established the relative distribution and abundance of wild black rats (*Rattus rattus*) across varied landscape in Bayelsa state and also to examined the impact of habitat characteristics in maintaining diversity of unique species of wild rat. The report of this study shall be useful in assessing the ecological health of Bayelsa state ecosystem using wild rat as bio indicators.

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MATERIALS AND METHODS

Study area: Bayelsa state, where this experiment was conducted, is situated in the lower deltaic plains of Nigeria is located at latitudes 5°22'-6°45' E and 4°15'-5°23' N, and has a population of about 1, 121693 people spread over a land area of 1200 km² (Alogoa, 1999). The vegetation of this unique plain is dynamic as it is composed of brackish water forest, fresh water swamp forest and mangrove forest. It has a mean annual rainfall ranged of 2000-4000 mm² spread over 8-10 months of the year. These unique attributes supports biodiversity of plants and animals.

Methodologically, the clustered settlement pattern and extent of development were used to map the study areas into three ecological zones, which reflects the ecological conditions in which wild rat could be found.

Zone 1: Zone of Stable Urban Centre (SUC), with stable agricultural transformation.

Zone 2: Zone of Rapid Urban Transformation (RUT) with a fast growing physical and agricultural transformation.

Zone 3: Zone of Undisturbed Rural Centre (URC) with little agricultural and physical transformation and low density of people.

Three ecological subsets were also mapped out from each zones using geographic positioning system. The sites include:

Site A: Undisturbed Landscape Area (ULSA)

Site B: Stable Human Settlement Area (SHSA)

Site C: Refuge Dump Site Area (RDSA)

Sample collection: Rats were collected from March, 2009-February, 2010 with two types of trap (a metal trap and improvised wooden trap) as described in Udonsi (1989). Trapping stations were established using standard procedures in Afework and Leir (1997). Each station was established at 3 m intervals along two trapping lines. Consequently, 6 trapping stations were established in each site of the zone. Traps were set in the afternoon (3.00-4.00 pm) and baited with bread and raw cassava tuber and left over night .Trapped rats were recovered every morning (6.00-8.00 am) and were taken to the department of Animal and Environmental Biology, University of Port Harcourt, Nigeria for identification. In most cases, rats were killed by anaesthetising in ether or chloroform. The rats were also separated into sexes based on Udonsi (1989).

Data analysis: The number of rats in each zone and sites were given mark tags and entered into Excel data base. The distribution/abundance of the rats was expressed as

Table 1: Trapping results of rats for each zone

Zones	Variables	Site A	Site B	Site C	Total
1	No. of trap nights	334	334	334	1002
	No. Captured	42	84	126	252
	Trap success (%)	12.5	25.1	37.7*	25.1
2	No. of trap nights	334	334	334	1002
	No. captured	120	281	225	656
	Trap success (%)	35.3	84.1*	61.4	65.4
3	No. of trap nights	334	334	334	1002
	No. captured	332	87	84	503
	Trap success	99.4*	26.0	25.1	50.4

Table 2: Specie richness or abundance in each site

Zones	Variables	Site A	Site B	Site C	Total
1	Specie richness	42	84	126	252
	Percentage (%)	16.7	33.3	50.0*	11.9
2	Specie richness	120	281	255	656
	Percentage (%)	18.2	42.8*	34.2	46.4
3	Specie richness	332	87	84	503
	Percentage (%)	66.0*	11.2	16.6	35.5
	Total	494	452	465	1411
	% specie richness	33.6	29.1	32.6	

Table 3: ANOVA table for rats caught in the various zones

Zones	SS	df	MS	F	Sig.
Between groups	42336.222	2	21168.111	1.626	0.273
Within groups	78114.667	6	13019.111		
Total	120450.9	8			

*: There is significant difference between the test zones; Reject H₀: (p<0.05); SS: Sum of Square; MS: Mean Square

percents of total rats caught in each zone, and the relationship between rat abundance and different ecological site were analysed using ANOVA while the influence of the site on the distribution of the rat population were analysed using Post Hoc Test and confirmed with the least significance difference at 95% confidence level.

RESULTS AND DISCUSSION

A total of 1411rats were caught over 3 sites in each study zone in 1002 trap nights representing a mean trap success of 46.9%. The trap success per site which, varied across the zones was recorded highest in zone 2 (99.4%), followed by zone 3 (37.7%) and least in zone 1 (25.1%) as indicated in Table 1.

A relative abundance of the rats caught across the zones varied from 11.9% to 46.4%, and was highest in zone 2 and least in zone 1 as shown in Table 2. Species richness also varied between sites in each zone. More rats (50.0%) in zone 1 were caught in site C while in zone 2 and zone 3; more rats were caught in site B(42.8%) and site A(66.0%), respectively. Statistical analysis of variance in Table 3 shows that there was a significant difference in the abundance of rat in the various study zones, ($F_{cal} = 1.626$, $p<0.05$). Furthermore the landscape (site structure) on rat population in each zone as compared in the Post Hoc Test (Table 4) was statistically significant.

These results have shown that the wide spread of wild black rats (*Rattus rattus*) in Bayelsa State is

Table 4: Post Hoc tests (multiple comparisons using LSD)

Izone-j site		Mean difference (i-j)	SE	Sig.	Lower boundary	Upper boundary	95% CL
1	B	-168.00	93.16	0.121	-395.96	59.96	
	C	-83.66	93.16	0.404	-311.62	144.29	
2	A	168.00	93.16	0.121	-59.96	395.96	
	C	84.33	93.16	0.400	-143.62	312.29	
3	A	83.33	93.11	0.404	-144.29	311.62	
	B	-84.32	93.11	4.400	-312.29	143.62	

*: LSD showed mean significant difference of rat population in different sites at 0.05 level of confidence.

influenced by habitat and vegetation structure. The observed catch distribution in the selected habitat types is in good agreement with the simple habitat selection strategy in Andrian *et al.* (2000).

The mean trap success of this study (46.9%) is higher than others recorded in some part of Tropical Africa. Iyawe (1988) recorded 6.5% trap success in various forest habitat of Nigeria. Makundi (1995) also recorded 2.25% trap success in Gallery forest of Tanzania while Varty (1990) had a trap success of 4.5% in Gallery forest of Somalia. The high trap success could probably be associated with the type of baits used. This observation is in consonance with Anadu (1979) who found out that bait type has considerable influence on trap success and a higher value might also be possible if a different bait has been used. In this present result, we have used cassava tubers and bread, which are natural food substrates of rat in the wild ands around human dwellings. These may have contributed to the high trap success in this study.

Differences in rat population in the various ecological zone and habitat types in the study locations are thought to be influence by ability of the rat to withstand stresses. The major ecological stress is landscape distortion and fragmentation of community type, (Flatter and Sieg, 2000). This is viewed as critical for wild life because it relates to the ability of habitat to meet breeding, feeding and shelter needs. The high percentage of rat population in zone 2 of the study location could be due to massive destruction of natural habitat of rat through urbanization and physical development. This may have resulted in the migration of black rat to human dwelling homes. Also, the high correlation between the numbers of rats caught and ecological zones may be explained by an increase in number of hiding places provided by zone 2 and zone 3 for better nesting, high foraging opportunities and/or high polyestrous status of the black rat to overcome the ecological stress. This result agrees with Udonsi (1989) and Andrian *et al.* (2000). However, the low percentage of rat population in zone 1 is an indication that there are no nesting and hiding places for the rat, thus exposing them to predatory attacks (Gregory *et al.*, 2009).

Variation also exists between rat populations in the different ecological sites of each zone. More rats were recorded in site C of zone 1, site B of zone 2 and site A of zone 3. These significant differences in the rat population of the study sites may be influenced by availability of enough food substrate, ranging from grasses, seeds, fruits,

cereals and kitchen dumps (Rabui and Fisher, 1989). Nearly all these food substrates were found distributed in the site to support the rat population. The low percentage in the other sites is an indication that the rat population can be influenced by ecological disturbances and are manipulated through land use activities. The undisturbed site A in zone 1 and zone 2 recorded low percentage of rat population. This is because the fairly untempered ecosystem may have not warranted the uneven movement of the rats from their nesting and hiding places, hence few were caught. Also, the low percentage in site B and site C of zone 3 is not surprising. This is a zone of low agricultural and urban transformation. The structure and function of the ecosystem is not subjected to any resilience. Perhaps, the rat has every resources within its reach, therefore, showed little or no forage activities in either human settlement or waste dump sites.

CONCLUSION

Results from this study have explained, that:

- Human induced manipulation of ecosystem can fragment the animal community and threaten the sustained biodiversity as wild rat (*Rattus rattus*) have shown high sensitivity and responsiveness to ecological changes in the study location of Bayelsa State.
- Zone 2 which is the zone of rapid urban transformation recorded the highest number of black rats caught. The implication is that, as part of the ongoing rapid transformation, city planners and agricultural engineers should use information here-in provided to design and construct good grain storage facilities to forestall postharvest losses in the hands of these wild black rats.
- *Rattus rattus* can be use as bio indicator to monitor the ecosystem health in an environment of growing populations.

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