Biometric characteristics of sampled snails in Makurdi metropolis, Benue state Nigeria

[1]Alarape, A. A., [2]Yager, G. O. and [2]Tyowua, B. T.

[1]Department of Wildlife and Ecotourism Management, University of Ibadan, Oyo State, Nigeria

[2]Department of Wildlife and Range Management, University of Agriculture, Makurdi, Benue State, Nigeria.

Email: gbrlyager@gmail.com, alarapeabideen@gmail.com

ABSTRACT

Snails are one of the most diverse groups of animals usually found in cool environment. Knowledge on microhabitat and snails biometric is important to snail farmers and researchers. This study investigated the biometric characteristics (snail length, diameter and weight) and assessed the floristic composition of their habitat from April to October 2013. (Achusa, Agbough, University of Agriculture Makurdi, NASME and Makurdi Zoological garden) were selected. Descriptive statistics and ANOVA were used for data analysis. Three species of snails were identified (Achatina achatina, Achatina depravata and Bulinus truncatus) and a total of 2,030 snails were collected. Daniellia oliveri formed the dominant plant species; however, both sample locations had a considerable composition of both vegetation species and snails species sampled. The mean shell weight of A. achatina (10.63 + 7.13g) is higher than A. depravata and B. truncates. The mean shell length of A. achatina was significantly different (P<0.05) from A. depravata and B. truncates. The mean shell diameter of A. achatina (5.29 + 1.04cm) was higher compared with A. depravata and B. truncates which were not significantly different (p>0.05).To ensure sustainable availability of snail in Makurdi metropolis the establishment of commercial snail farms that can meet the short-fall between demand and supply from the wild during the rainy season is imperative.

Keywords: Microhabitat, snails biometric, species

INTRODUCTION

Snails are bilaterally symmetrical invertebrates with soft-segmented exoskeleton in the form of calcareous shells. They belong to the phylum mollusca and class Gastropoda (Ramzy, 2009). In West Africa, snails dwell mostly in humid forest and urban areas from where they are gathered by villagers for consumption and other uses (Ademosun and Omidiji, 1999). These snails belong to a group of livestock called micro livestock as a result of small body size (Agbogidi, *et al.*, 2008). Both terrestrial and aquatic snails range in size from about 1mm long to the giant African snails, which occasionally grow up to 312mm (12¼ cm) in length. Most breeds vary in their adaptability to the environment, egg size, size at day old, size at maturity and growth rate (Amusan and Omidiji, 1999). Ajetunmobi and Olayemi (2002), maintained that the difference in size may be explained partly by differences in the length of the aestivation period.

Under natural conditions, snails are exposed to a range of varying and often interacting environmental factors that produce collective effect on them and it is usually difficult to separate the effect of any one factor from others (Cameron and Pokryszko, 2005). Gastropods are one of the most versatile groups of molluscs, characterized by an extraordinary biodiversity and capacity to adapt to various environmental conditions. Biometric variations of snail shells have been documented, but their major determinants are poorly understood (Barker, 2005). Thus, distance between two populations can induce shell size variability within species (Madec and Bellido, 2007). According to Olawoyin and Ogogo, (2006) shell length is a better predictor of body weight for growing snails. However, weight gain could be subject to changes in environmental factors that could trigger desiccation, and reduce the weight of the snails.

In Nigeria, wild snails and other species are on the decline due to frequent exploitation, deforestation, and other human activities (Oke *et al*., 2008). Snails present a wide variety of terrestrial habitats which undoubtedly has influenced snail diversity. However, humans have used snails for food for many generations and despite this, most of the scientific work done on snail in West Africa has been from the point of view of feeding and animal parasitology where snails act as intermediate host of pathogenic nematodes (Wosu, 2003). Consequently there is heightened interest in commercial production of snails and the demand to produce high yield is on the increase.

Biometric data and urban microhabitat of snails in the area is of critical importance since there is a sharp decline in its abundance in the few remaining natural habitat (Tyowua *et al*., 2017). Snails constitute a seasonal industry upon which some of the rural economics depend. The research work therefore explored the urban microhabitat and snails' biometrics characteristic in terms of weight and length.

METHODOLOGY

The study was carried out in Makurdi metropolis, Benue State, Nigeria. Makurdi lies within the Southern Guinea Savannah Zone, between latitude 7° 38' to 7° 52'N and longitude 8° 20' to 8° 38'E (Fig.1). The soils are moderately deep to very deep, ranging in depth from 55cm on the crest and upper-slope to 200cm in the lower-slope. The terrain is basically an undulating plain. Its relief ranges between 83m to 167m above sea level. The drainage system comprises of tributaries of river Benue which include Bar and Demekpe. The wet season is from April to October while the dry season is from November to March and the average annual rainfall was between 150 and 180 mm, relative humidity is between 60% and 80% but decrease in the early month of dry season (Jimoh *et al.,* 2009). The vegetation of the area is characterized by pattern of secondary forests regrowth interspersed by extensive savanna with very tall grasses and was primarily dominated by trees species like *Daniellia oliveri, Prosopis africana* and *Parkia biglobosa* while predominant grasses include A*ndropogon gayanus, Hyparrhenia involucrata* and *Imperata cylindrical. Chromolaena odoratum* is a common herb in the area especially close to river bank (Idoga., 2005).

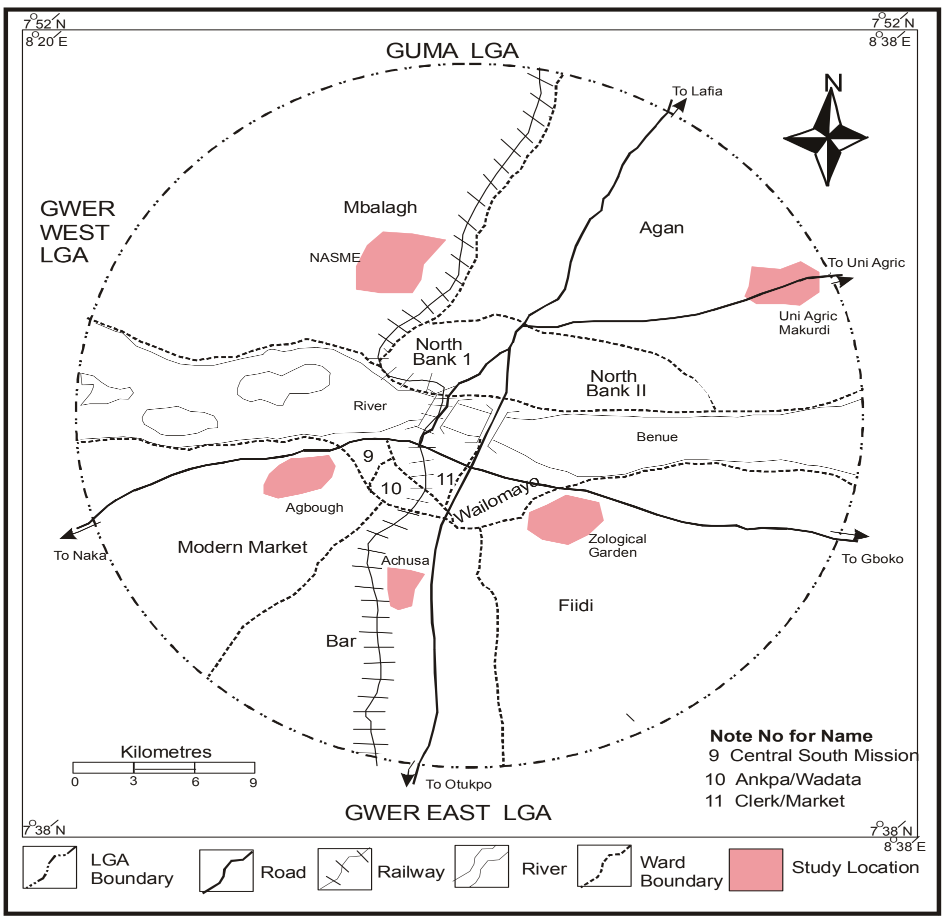

Figure 1: Map of Makurdi Local Government Area showing study location
Source: Ministry of Lands and Survey Makurdi, (2013)

Data Collection

Eleven (11) council wards namely: Mbalagh, Agan, North Bank I, North Bank II, Fiidi, Bar, Modern Market, Walomayo, Akpan Wadata, Central South mission and Clerk market ward were mapped. Five (5) council wards which had evidence of snails' presence were purposively selected and a location in each of the council ward was randomly selected through balloting, namely Zoological Garden (Fiidi), Achusa (Bar), University of Agriculture (Agan), Agbough (Modern market) and Nigerian Army School of Military Engineering (NASME) (Mbalagh), respectively. In each of the locations, a

30m x 30m plot was laid and six 5m x 30m sub-plots were demarcated for sample collection in each location. The plots were marked with flagging tapes. A total of thirty (30) sub-plots were searched for snail for thirty minutes. This was done four times per month from April to October 2013. The time quantitative searches method by various investigators (Emberton *et al.,* 1996; Bishop, 1977; Cameron and Pokryszko, 2005) was adopted. The searching covered both day and night time and commenced at 6.30am to 9.30am and 6 to 7pm when snails were still very active as adopted by (Ajayi, 1978). Snails were handpicked with gloved hands from trees, bushes and ground surface and placed in plastic container and taken to the Fisheries laboratory in the University of Agriculture Makurdi for identification. Woody plant and shrubs species were identified in each of the 30m x 30m plot and all the herbaceous species using $1m^2$ quadrat frame within sub-plots.

Biometric measurements of collected snails

The following measurements were taken; weight of shell/snail with meat using sensitive electronic balance of 0.00g sensitivity. Shell length-using rope and meter rule and shell diameter-using vernier caliper at the widest part for each snail.

Data Analysis

Descriptive statistics was used for description of snails' characteristic and Analysis of variance (ANOVA) was used to test for significant difference set at α=0.05. Data was further subjected to Duncan multiple Range test to separate the differences among means for snail biometric characteristics.

RESULTS AND DISCUSSIONS

Microhabitat of the sample locations

Sixteen woody plants species in 10 families were identified in the study locations (Table 1). *Daniellia oliveri* was the dominant species with 22.3%, followed by *Azadirachta indica* (16.6%) and the least occurring species were *Pseudocedrela kotschyi Sarcocephalus latifolius and Allophylus africanus* with 1.4% respectively. The result of herbaceous species at different locations presented in Table 2 reveal the presence of nineteen herbaceous species representing 12 families in the various areas. Both locations present a suitable range condition in protected urban vegetation for snails' survival. In the same vain, the occurrence and composition of forage species may be attributed to the availability of suitable microhabitat composition in terms of shelter, food and oviposition site by the snails. This is in line with the report by Ikpa *et al.,* (2006) and Joseph (2008) that snails thrive well in suitable range environments.

Table 1: Woody plant composition across locations in the study area

Species	Family	Locations						
		Achusa	Agbough	NASEM	UAM	MZG	Frq	%
Mangifera indica Linn.	Anacardiaceae	4	1	3	1	3	12	8.63
Annona senegalensis pers.	Annonaceae	0	0	0	3	5	8	5.76
Elaeis guineensis Jacq.	Arecaceae	4	2	2	4	10	22	15.83
Newbouldia laevis (P. Beauv.) Seemann exBureau	Bignoniaceae	2	0	0	2	0	4	2.88
*Terminalia catappa (*Singapore almond) - Cabi	Combretaceae	1	0	2	0	0	3	2.16
Terminalia glaucescens Planch. Ex Benth.	,,	0	0	0	2	2	4	2.88
Anthoclesta djalonesis A.Chev.	Gentianaceae	0	0	4	6	0	10	7.19
Acacia sieberiana var. Sieberiana	Leguminosae	1	0	0	0	2	3	2.16
Daniellia oliveri (Rolfe) Hutch. & Dalz.	,,	0	0	6	10	15	31	22.30
Prosopis africana (Guill. & Perr.) Taub	,,	0	0	0	0	2	2	1.44
Azadirachta indica A. Juss	Meliaceae	2	1	5	8	7	23	16.55

Species	Family	Locations						
		Achusa	Agbough	NASEM	UAM	MZG	Frq	%
Pseudocedrela kotschyi (Schweinf.) Harms	,,	0	0	0	2	0	2	1.44
Ficus exasperata Vahl	,,	0	1	0	4	3	8	5.76
Sarcocephalus latifolius (JE Sm) EA Bruce	Rubiaceae	0	2	0	0	0	2	1.44
Allophylus africanus P.Beauv	Sapindaceae	0	1	0	0	1	2	1.44
Vitex doniana Sweet	Verbenaceae		0	0	2	1	3	2.16
Total		**14**	**8**	**22**	**44**	**51**	**139**	**100**

Source: Field Survey, 2013

Key: NASME = Nigerian Army School of Military Engineering, UAM = University of Agriculture Makurdi, MZG = Makurdi Zoological Garden

Table 2: Identified herbaceous species across locations in the study area

Species	Family	Locations				
		Achusa	Agbough	NASME	UAM	MZG
Ageratum conyzoides L.	Asteraceae	×	×	×	✓	×
Amaranthus spinosus L..	Amaranthaceae	✓	×	×	×	×
<u>*Combretum nigricans*</u> Lepr. ex Guill. & Perr.	Combretaceae	✓	×	✓	✓	✓
Luffa cylindrica (L.) Roem., Syn. Monogr.	Cucurbitaceae	✓	✓	✓	✓	×
yperus iria L.	Cyperaceae	✓	×	×	×	✓
Indigofera arrecta - Hochst. ex A.Rich.	Fabaceae.	X	✓	✓	✓	✓
Echinochloa colona L. Link	Gramineae	×	×	×	✓	✓
Centrosema pubescens Benth.	Leguminosae	×	×	×	✓	×
Tephrosia maxima (L.) Pers.	,,	×	✓	×	×	×
Sida acuta Burm.	Malvaceae	X	x	✓	✓	✓
Urena lobata L.	,,	✓	✓	X	x	✓
Andropogon gayanus Kunth	Poaceae	✓	×	×	×	×
Cynodon dactylon (L.) Pers. var. Dactylon	,,	×	×	×	✓	×
Imperata cylindrica (Linnaeus)	,,	✓	×	×	×	×
Panicum maximum Jacq.	,,	×	×	×	✓	×
Paspalum orbiculare G. Forster	,,	✓	×	×	×	×
Pennisetum unisetum (Nees) Benth.	,,	✓	×	×	✓	✓
Physalis angulata L.	Solanaceae,	×	✓	×	×	×
Cissus rufescens var. doeringii (Gilg & Brandt) Desc.	Vitaceae	×	×	×	×	✓

Source: Field Survey, 2013

Snail Samples: Three species of snails identified include two edible land species and one non-edible species, that is *Achatina achatina* , *Achatina depravata and Bulinus truncatus* (Plates 1- 3). *B. truncatus* is recognized as an intermediate host for schistosomiasis in Nigeria and not been consumed (Agi and Okwuosa 2001). *A. achatina* was the most abundant species (1,386*),* followed by *A. depravata* (159) and *B. truncates* (129) throughout the period of snail collection (Fig. 2). This indicates a relatively high occurrence and abundance of snail population sampled. Among the sampled snail species *A. achatina* has the advantage of high adaptability, survivability, highly prolificacy and fleshier. In terms of location, the Zoological garden area had the highest (n = 505) snails collected, followed by the Achusa location (n = 409) and the least was NASME with (n = 329). Snail species concentration observed more at Makurdi zoological garden and Achusa, could be attributed to the fact that both locations form part of the tributaries along the shores of River Benue, and present a favourable effect of both vegetation and soil on snail habitat preference. Habitat across locations had some type of savanna vegetation sparsely distributed within or at the verge of the sample locations. Snails were often seen clustering around vegetation and some floating on waterborne pieces of wood or plant materials. Whitton (1975) and Obureke *et al.,* (1987) attributed the clustering of snails around plants to be due to high oxygen gradient produced by these plants. The mean distribution of snails collected from the selected locations was significantly different ($p<0.05$).


Plate 1: Adult *Achatina depravata* (edible)


Plate 2: Adult *Achatina achatina* (edible)


Plate 3: Adult *Bulinus truncatus* (a vector)

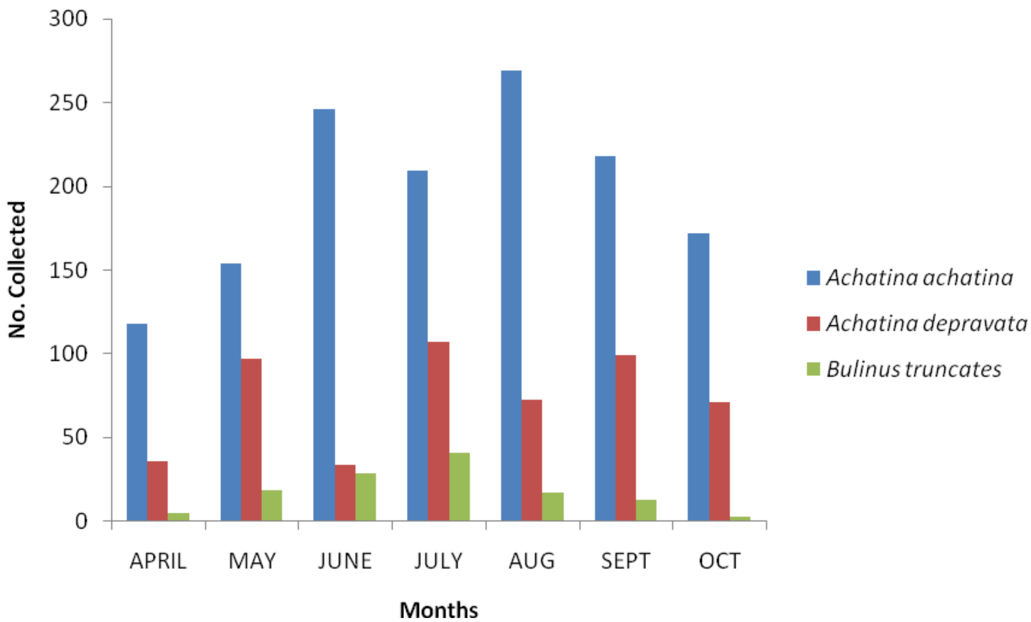

Fig 2: Number of Snails species collected during the study period

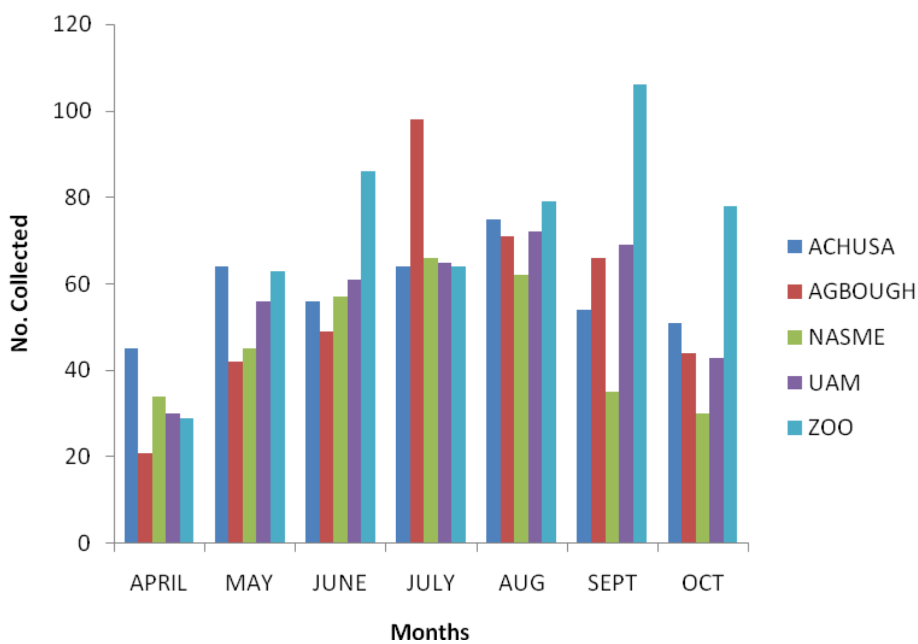

Fig 3: Distribution and abundance of snails collected for seven months

Snail Biometrics: The mean shell weight of sampled snail species at UAM was the highest with 11.22 - 5.19g and the least mean species weight of 8.05 ± 4.54g at NASME. Furthermore, the mean shell weight of *A. achatina* (10.63 - 7.13g) was higher than *A. depravata and B. truncatus.* The mean shell length of *A. achatina* was significantly different ($P<0.05$) from A. depravata and B. truncates. The mean shell diameter of *A. achatina* (5.29 - 1.04cm) was higher compared with *A. depravata* and *B. truncatus* which were not significantly different ($P>0.05$) (Tables 3 – 5). The biometric characteristics showed significant difference ($p<0.05$) with regard to the weight gain and length variation of the three snails obtained at the five different locations which indicates a growth indicator. Similarly, Olawoyin and Ogogo (2006) reported shell length as a better predictor of body weight for growing snails. However, weight gain could be subject to changes in environmental factors that could trigger desiccation, and reduce the weight of the snails. There are many of such factors that affect snails, and even determine their distribution in their natural environment (Ikpa *et* *al*., 2006). Given such possibility, the whole mean weight of snails alone may therefore, may not be a better option for assessing the growth in snails, since it could drastically be influenced by environmental factors. Also Hodasi, (1979) and Omole *et al*. (2000) reported that diets containing higher percent protein were optimal for the growth of snails. This could be attributed to the enhanced growth performance of snails on diet present and the positive correlation between growth performance, shell length and shell width. A positive correlation between live weight gain, shell length gain, and shell width gain had been established especially in growing snails (Odunaiya and Akinnusi, 2008).

The general trend was an increase in length diameter and weight of snails within seven months period during the major and minor peak snail season of 2013. This reveals that length and weight gain of sampled snails in the major peak snail season were higher than those of the minor peak snail season of April, 2013. This agrees with the reports of Stephen, (1999) and Frest (2004). The increase in the shell length and shell diameter indicates that leaves of plants as well as the diets aid in the entire body growth of the snails (Ejidike, 2002). Favourable climate and low level of habitat disturbance have enabled the snails to grow significantly faster at levels that may be comparable to those raised under controlled feeding regimes in captive environment (Goodman, 2003).

Table 3: Mean shell weight (g) of snails species sampled in five different locations

Locations	*Achatina achatina*	*Achatina depravata*	*Bulinus truncatus*	Mean weight Total
Achusa	15.29 ± 10.67	9.36 ± 4.22	9.47 ± 4.65	$9.90^{b} \pm 5.51$
Agbough	6.66 ± 3.29	7.59 ± 4.23	8.52 ± 4.07	$8.12^{d} \pm 4.09$
NASME	14.12 ± 4.16	7.78 ± 3.55	7.97 ± 4.67	$8.05^{de} \pm 4.54$
UAM	11.57 ± 5.74	12.27 ± 5.56	10.73 ± 4.93	$11.22^{a} \pm 5.19$
MZG	9.26 ± 4.37	9.08 ± 4.80	9.68 ± 4.76	$9.47^{c} \pm 4.73$
Mean ± SD	$10.63^{a} \pm 7.13$	$9.38^{b} \pm 4.95$	$9.33^{bc} \pm 4.72$	

Means in the same row/column followed by different superscripts differ significantly ($p<0.05$)
Species*Location F= 6.024, P<0.05

Table 4: Mean shell length (cm) of snails species at five different locations

Location	*Achatina achatina*	*Achatina depravata*	*Bulinus truncates*
Achusa	5.61 ± 1.47	5.39 ± 1.16	5.44 ± 1.26
Agbough	5.41 ± 0.87	5.05 ± 1.43	4.97 ± 1.26
NASME	4.92 ± 0.59	5.15 ± 1.31	5.26 ± 1.28
UAM	5.63 ± 1.13	5.66 ± 1.23	5.68 ± 1.91
MZG	5.57 ± 1.37	5.32 ± 1.17	5.14 ± 1.31
Mean±SD	$5.52^{a} \pm 0.35$	$5.32^{b} \pm 1.27$	$5.29^{bc} \pm 1.04$

Means in the same row followed by different superscripts differ significantly ($p<0.05$)
Species*Location F=1.813, P<0.05

Table 5: Mean shell diameter (cm) of snails species sampled at five different locations

Locations	*Achatina achatina*	*Achatina depravata*	*Bulinus truncates*
Achusa	2.78 ± 0.69	2.07 ± 0.29	2.12 ± 0.31
Agbough	2.40 ± 0.10	1.89 ± 0.29	1.99 ± 0.21
NASME	2.80 ± 0.57	2.06 ± 0.26	2.06 ± 0.32

Locations	*Achatina achatina*	*Achatina depravata*	*Bulinus truncates*
UAM	2.43 ± 0.68	2.25 ± 0.31	2.12 ± 1.17
MZG	2.51 ± 0.63	2.10 ± 0.35	2.09 ± 0.33
Mean ±SD	2.53 ^{a} ± 0.61	2.11^{bc} ± 0.32	2.13^{b} ± 0.60

Means in the same row followed by different superscripts differ significantly ($p<0.05$)
Species*Location F=21.402, $p<0.05$

CONCLUSIONS

Three species of snails *(Achatina achatina*, *Achatina depravata* and *Bulinus truncates)* were identified. *Daniallia oliveri* dominated the woody species. Snails were more concentrated in Achusa and Makurdi zoological garden. Snails in the study areas increased in length, diameter and weight. Shell length indicated the weight of the snails. Snails' are vulnerable to changes in environmental conditions and many species of land snails are living close to their thermal and desiccation tolerance due to the removal of the shade trees in their habitat because of deforestation and habitat loss. Various microhabitats may be used for the rearing of snails, depending on the suitability and availability of such-microhabitats to ensure sustainability and productivity. It is hereby recommended that people should be educated on the effect of snails' overexploitation and preservation of urban vegetation should be encouraged to enhance snails' survival and populations increase.

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