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Influence of two management systems on the growth performance of adult African giant land snails (*Archachatina marginata*)

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Abstract
African gaint land snails are important as means of alleviating acute protein shortage in Nigeria livestock Industries. The present study aimed to study the influence of intensive and extensive management systems on the growth Performance of adult African Giant Land Snails (*Archachatina marginata*) was carried out in the wildlife domestication unit of the Department of Forest Resources and Wildlife Management, University of Benin, Benin City, Nigeria. Ninety African giant land snails (*A. marginata)* of average body weight 160.31g ± 0.38g were used for the study. The snails were grouped into two- Group A and Group B. 45 snails in group A were raised in an intensive system of management while 45 snails in group B were raised in an extensive system of management. The data collected on weight gain, shell length increment and shell width increment during the experiment were subjected to student t-Test at 5% significant level. Results showed that there was a significant difference at ($p<0.05$) in the weight gain. The intensive management system had a higher weight gain of 128.96g with mean value of 4.96 while the extensive management system had a weight gain of 88.37g with mean value of 3.40. There was no significant difference at ($p>0.05$) in the shell length increment. The snails in the extensive management system had the higher shell length increment of 5.32cm with mean value of 0.20 while the snails in the intensive management system had a shell length increment of 2.43cm with mean value of 0.09. There was a significant difference at ($p<0.05$) in the shell width increment. The snails in the extensive management system had the higher shell width increment of 9.31cm with mean value of 0.36 while the snails in the intensive management system had a shell width increment of 4.30cm with mean value of 0.17. The snails in the intensive system had a Feed Conversion Ratio of 5.03. For better growth performance of *A. marginata* in terms of weight gain, snail farmers should raise their snails in an intensive system of management and formulated diet should be used in feeding the snails along side with natural feed such as leaves and fruits.

Keywords: African giant land snails, Feed Conversion Ratio, Shell length increment, Weight gain

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INTRODUCTION

Snails are bilaterally symmetrical invertebrates with soft segmented exoskeleton in the form of calcerous shells and belong to the phylum mollusca. In west Africa, snails dwell in humid forest areas from where they are gathered for consumption and other uses (Ademosu and Omidiji, 1999). Snails are invertebrate shell bearing animal that are passive or inactive during the day but very active in the night, at dusk or when it rains. They are usually found in cool environment (Amusan and Omidiji, 1999; Omole, 2001). Snails are the largest group of molluscs constituting the largest animal group next to arthropods. They have high rate of productivity or fecundity, although they are hermaphrodite, and practice sexual reproduction (Akinnusi, 2004). The giant land snails are non-conventional protein sources whose meat is a highly relished delicacy (also known as *'Congo meat'*) and constitutes an important source of animal protein in many coastal communities of Nigeria and other parts of Africa (Omole et al., 2007**)**. Snail meat is regarded as a form of bush meat or game meat to be eaten occasionally instead of being a nutritious meat to be relished on a daily basis just like the meat of other conventional livestock (Malik and Dikko, 2009). Some ethnic groups even have superstitious beliefs that dis-

courage the eating of snail meat or the eating of certain species of snails to the detriment of others. Uboh et al. (2010) observed *Archachatina marginata* to be generally accepted for consumption, and strong cultural discrimination in the consumption of *Achatina achatina* by some tribes in Southern Nigeria. Studies by Omole et al., (2000) have shown that different breeds of snails can be found in Nigeria and they are characterized by high efficiency of nutrient transformation into quality protein. The African giant land snail (*A. marginata*) is the largest known snail in Africa (Omole, 1998; Olawoyin and Ogogo, 2006) and dwells naturally in the forest litters of the tropical rainforest zone of Nigeria (Adedire et al., 1999). Omole (1998) stated that the African giant snail (*A. marginata*) is the most common edible land snail found and reared in Nigeria. A short supply of wild population of snail is on the increase due to decline in snail population resulting from human impacts and other anthropogenic factors such as deforestation, slash and burn agricultural practices and over exploitation of these animals (Eneji, Ogogo, Emmanuel-Ikpeme and Okon, 2008; Raut and Barker, 2002). It has been reported that snail's availability is seasonal (Ugwu, Ogbu and Ikechiuno, 2011), being much more available in the rainy season and scarce during the dry season (Oshiyemi, 2011), because they aestivate during the dry season (Okafor, 2001). The primary task of addressing the malnutrition problems through increased animal protein intake requires production of protein from animal sources in the right quantity and quality. The contribution made by domestic animals (conventional sources) as protein supply are not enough, there is therefore need to look at some unconventional sources (Etchu, *et al*., 2008). To achieve this, there is need to encourage the raising of some wildlife species such as snail and cane rat. Snails have become a tool for poverty alleviation (Ebenso, 2006) and it has been discovered that snail production is associated with rapid returns per unit investment (Adinya, 2006). The objectives of the study was to determine the growth performance of African giant land snail (*A. marginata*) in terms of weight gain, shell length increment, shell width increment, feed intake and feed conversion ratio.

MATERIALS AND METHODS

Study area: The experiment was carried out in the Wildlife domestication unit of the Department of Forestry and Wildlife, University of Benin, Benin City, Nigeria. The Ugbowo main campus of the University of Benin has a total land area of 1,748 hectares. It is located between latitude 6.1^0 N and 6.8^0N of the equator and longitude 5.4^0E and 6.0^0E of the Greenwich meridian. The altitude is 74.5m above sea level.

Experimental snails: Ninety African giant land snails (*A. marginata)* of average body weight 160.31g±0.38g were used for the study. The snails were grouped into two- Group A and Group B. 45 snails in group A were raised in an intensive system of management while 45 snails in group B were raised in an extensive system of management. The intensive system of management is a system of management where the animals (snails) are confined in an enclosure and restricted from moving freely, feed and water are provided to the animals on a daily basis, the eggs and the young ones are well taken care of and the enclosure checked regularly to ensure that the animals are comfortable. The extensive system of management is a system of management where the animals (snails) are allowed to move freely in a large expanse of land, they feed on the plants and other sources of food in the environment, rely on water from rainfall, the eggs are left to hatch naturally and the young ones are left to grow with the adult ones.

Housing: Wooden cage of dimension 4.5m × 0.6m × 0.5m (Ejidike, 2001) was constructed and used to house the snails in group A. The cage was divided into 3 parts with each part of dimension 1.5m × 0.6m × 0.5m. The cage stood 40cm off the ground. 45 snails in group A were grouped into 15 snails per replicate (replicate I-III) and stocked randomly in each part of the cage. The cage was filled with loamy soil up to 18cm thickness. The other 45 snails in group B were housed in an extensive system of management. The snails were placed in a free-range pen. An area of 9m x 3m x 2m was established, snail plant food materials and shelter plants were planted within the enclosure. The snails were allowed to move over the entire area-free range. The area was divided into 3 parts (three replicates) each of dimension 3m × 3m x 2m. Fifteen snails were stocked in each of the part.

Experimental design and treatment: A Completely Randomize Design (CRD) was used in the experiment. The ninety (90) snails were randomly distributed to 2 treatments - the intensive management system and extensive management system. Each of the treatment was replicated 3 times, with 15 snails per replicate and 45 snails per treatment.

Feeding and watering: Feed were supplied to the snails in the intensive management system at 1800 hours. Feeding was done in the evening and the left over feed in the subsequent evening was weighed. This was to ensure that their food is always fresh at the time of feeding as snails are nocturnal animals. The weight was subtracted from the initial weight of the feed supplied to estimate the feed intake. The Feed Conversion Ratio was calculated as the ratio of feed intake to weight gain. Formulated feed of 25% crude protein was also used to feed the snails. Natural feeds like

fruits of pawpaw, watermelon, pineapple and leaves of pawpaw and cocoyam were used to feed the snails. The natural and formulated feed were given to the snails at alternate days. Water was provided to the snails by making the soil moist as snails have the ability to obtain water from moist soil. Regular cleaning of the snailery and utensils as well as routine management practices were ensured. The snails in the extensive management system were allowed to feed naturally on the plant materials planted within the enclosure. Pawpaw and cocoyam plants were planted within the enclosure to serve as source of food and shelter for the snails.

Data collection: Data were collected on the weight gain, shell length increment, shell width increment, feed intake and Feed Conversion Ratio for a period of 52 weeks. The snails were marked with a permanent marker for easy identification. The weight gain, shell length increment and shell width increment of the snails were measured once every two weeks. The weight of the snails were measured using an electronic weighing balance, the shell length was measured by using a measuring tape from the tip of the shell to the base and measured to the nearest centimeter, the shell width was measured by using a thread to measure the broad circumference of the shell and the values were read off on a ruler to the nearest centimeter.

Statistical analysis: The data collected on weight gain, shell length increment and shell width increment during the experiment were subjected to student t-Test at 5% significant level.

RESULTS

Snail weight gain: The result of the snail weight gain revealed that there was a significant difference at ($p<0.05$) in the weight gain of the two management systems. The intensive management system had the higher weight gain of 128.96g with mean value of 4.96 while the extensive management system had a weight gain of 88.37g with mean value of 3.40 (Table 3).

Snail shell length increment: The result of the snail shell length increment revealed that there was no significant difference at ($p>0.05$) in the shell length increment of the two management systems. The snails in the extensive management system had the higher shell length increment of 5.32cm with mean value of 0.20 while the snails in the intensive management system had a shell length increment of 2.43cm with mean value of 0.09 (Table 4).

Snail shell width increment: The result of the snail shell width increment revealed that there was a significant difference at ($p<0.05$) in the shell width increment of the two management systems. The snails in the extensive management system had the higher shell width increment of 9.31cm with mean value of 0.36 while the snails in the intensive management system had a shell width increment of 4.30cm with mean value of 0.17 (Table 5).

Snail feed conversion ratio (FCR): The result of the Snail Feed Intake and the Feed Conversion Ratio (FCR) in the intensive system is represented in Table 6.

DISCUSSION

The growth performance of *A. marginata* in the intensive and extensive management systems were measured by the weight gain, shell length increment and shell width increment. The snails in the intensive management system had a higher weight gain than the snails in the extensive management system. This could be as a result of the formulated feed of 25% crude protein in addition to the natural feed used in feeding the snails. This agrees with the findings of Omole (2002) that weight gain of snail is directly proportional to the level of protein in the diet. This is also in agreement with Akintomide (2004), that African land giant snails like other farm animals prefer to be fed on a combination of feeds rather than just feeding on a particular type of food. The higher weight gain of snails in the intensive management system could be as a result of the high crude protein in the diet. This finding is also in agreement with Adeyemo and Borire (2000) that reported significant differences in the body weight gain of snails fed different levels of yam peel. The snails in the extensive management system had higher shell length and shell width increment than the snails in the intensive management system. The increase in shell length and shell width occurred throughout the year even in the dry season. This is an indication that snails grow in shell size even during the

Table 1. Percentage composition of the formulated feed with 25% crude protein.

Ingredients	Percentage (%) composition
Maize	50.00
Soyabean meal	15.00
Groundnut cake	15.00
Fishmeal	5.00
Bonemeal	10.00
Vitamin premix	2.50
Limestone	2.50
Total	**100**

Table 2. Proximate composition of feed.

Composition	Percentage (%)
Ash	8.25
Dry matter	90.73
Lipid	3.14
Crude fibre	3.27
Moisture content	9.27
Crude protein	24.50
Nitrogen Free Extract (NFE)	51.57

Source: Laboratory Analysis, 2018

Table 3. *Archachatina marginata* mean weight gain (g).

	Intensive system	**Extensive system**
Initial body weight	160.31 **±** 0.38	160.31 **±** 0.38
Final body weight	289.27	248.68
Total Weight gain	128.96	88.37
Mean weight gain	**4.96[a] ± 1.02**	**3.40[b] ± 0.94**

Means with different superscript indicated that they are significantly different at ($p<0.05$)

Table 4. *Archachatina marginata* mean Shell length increment (cm).

	Intensive system	**Extensive system**
Initial shell length	9.98 ± 0.15	9.98 ± 0.15
Final shell length	12.41	15.30
Total shell length increment	2.43	5.32
Mean shell length increment	**0.09[a] ± 0.01**	**0.20[a] ± 0.01**

Means with the same superscript indicated that they are not significantly different at ($p>0.05$)

Table 5. *Archachatina marginata* mean Shell width increment (cm).

	Intensive system	**Extensive system**
Initial shell width	17.12 ± 0.30	17.12 ± 0.30
Final shell width	21.42	26.43
Total shell width increment	4.30	9.31
Mean shell width increment	**0.17[a] ± 0.02**	**0.36[b] ± 0.02**

Means with different superscript indicated that they are significantly different at ($p<0.05$)

Table 6. *Archachatina marginata* Feed Conversion Ratio (FCR).

	Intensive System
Total Feed Intake (g)	648.74
Total Weight Gain (g)	128.96
Feed Conversion Ratio (FCR)[1]	5.03

[1]FCR = Total Feed Intake/ Total Weight Gain

dry season, though the growth rate was reduced. The higher shell length and shell width increment of the snails in the extensive management system could be due to the spacious environment in which the snails in the extensive management system were exposed to. Snails grow well when the environment is spacious and have free access to their feed. This is in line with the findings of Ayodele and Asimalowo (1999) that the performance of snails are affected by space and number. The high Feed Conversion Ratio (FCR) of *A. marginata* (5.03) is in line with Badmos et al. (2011) who reported FCR range of 1.40 to 1.61 for growing *A. marginata*, while Ademolu et al. (2014) reported FCR range of 1.33 to 4.84 for one month old *A. marginata*. The high feed conversion ratio of *A. marginata* is an indication that *A. marginata* did not utilize the nutrients available in the 25% crude protein diets efficiently.

Conclusion

From these results, it could be deduced that the formulated feed of 25% crude protein used in feeding the *A. marginata* in the intensive system of management contributed to the higher weight gain while the snails in the extensive system of management had a higher shell length and shell width increment probably because of the large space they were exposed to. The feed conversion ratio of *A. marginata* was high indicating that the *A. marginata* did not utilize and convert the feed to body tissues efficiently. For better growth performance of *A. marginata* in terms of weight gain, snail farmers should raise their snails in an intensive system of management and formulated diet should be used in feeding the snails along side with natural feed such as leaves and fruits.

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