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# EFFECT OF MICRO-HABITAT ON THE EGG HATCHABILITY AND HATCHLING GROWTH PERFORMANCE OF THE GIANT AFRICAN LAND SNAIL (*Archachatina marginata*)

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## Abstract

The effect of selected micro-habitats on the egg hatchability and hatchling growth performance of the Giant African land snail *Archachatina marginata* was investigated in an experiment conducted in the Research and Teaching Farm of the Delta State University Asaba Campus, Delta State Nigeria. The experiment was conducted over a period of six months. Five different micro-habitats were selected. These include river sand, top soil, sawdust, mud and decayed vegetation. Parameters measured include weight of eggs, length of eggs and percentage hatchability. Bi-weekly variation in hatchling weights and average weight gain over a period of ten weeks was also recorded. Significant differences between the groups were observed for egg weight and egg length, with sawdust, mud and decayed vegetation recording higher values than top soil and river sand. Post hoc tests revealed 100% hatchability for eggs placed in top soil and river sand, 95% hatchability for eggs placed in mud and decayed vegetation and 71% hatchability for eggs placed in sawdust. Results obtained for hatchling weights indicate bi-weekly significant differences between the groups. Results obtained from the experiment indicate that top soil and river sand are suitable micro-habitats for the hatching of snail eggs, while sawdust is a suitable medium for subsequent growth of the hatchlings.

***Keywords:*** Top soil, river sand, mud, decayed vegetation, sawdust, % hatchability, egg length, egg weight, hatchlings.

## Introduction

Most of the developing countries in the world, especially Africa are currently being plagued with an alarming drop in per capita income and food production, particularly in the last few decades (Isikwenu, 2001). The food deficient situation is indeed more serious with protein deficiency when compared to other food sources. The alarming increase in population implies that many people require the supply of protein in their diet because of its important role in human growth and development (Ademolu *et al*, 2004). Most of the conventional animal protein sources such as beef, goat, pork and poultry products have become too expensive for the average citizen. These major sources are decreasing at an alarming rate due to persistent drought, disease, high cost of feed and primitive husbandry techniques (Siyanbola, 2008). In order to provide a cheaper source of protein for human consumption, there is need for an intensive system of rearing alternative sources of animal protein, in the form of game meat and snail meat. It has been observed that collection of such sources from the wild cannot meet man's demand for protein (Ejidike, 2007). 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.

Snail as a micro-livestock has attracted attention among agriculturists and farmers in Nigeria as an aftermath of an alarm raised by Food and Agriculture Organization (FAO) on animal protein deficiency among Nigerians (Hamzat *et al*., 2005). The art of rearing snails has turned out to be a household venture in recent times (Ademolu *et al*., 2004, Lameed 2006, Ejidike 2007, Siyanbola 2008). Many people are practicing snail farming both as small and large scale enterprises (Amusan *et al*., 1998). Snail meat is a high quality food that is rich in protein, low in fats and a good source of iron (Orisawuyi 1998) and calcium, magnesium and zinc (Ademosun *et al*., 2004). Imevbore and Ademosun (1988) assessed the nutritive value of snail meat and found that it has a protein content of 88.3%. This value compares favorably with conventional animal protein sources whose values range from 82.42% (pork) to 92.75% (beef). Studies by Akinnusi (1998) revealed that snail meat contains 70% water while it is high in essential amino acids such as lysine, leucine, arginine and tryptophan. Snail is also a source of calcium ortho-phosphate, which is a chemical substance for curing kidney problems (Imevbore and Ademosun, 1988). The availability of giant land snails in the world is decreasing gradually through indiscriminate hunting and deforestation which destroys the snail's natural habitat (Ademolu *et al*., 2004). It has been observed that snails collected from the wild cannot meet man's demand as a source of protein (Siyanbola 2008), hence there is need to rear them on a household and on a commercial basis. Ejidike (2004) has shown that feeding plays a vital role in the survival, growth and reproduction of most cultivated animals and have shown that snails' feed conversion rates are quite high compared to some other micro-livestock. According to Murphy (2001), snails have been and are still very much a sought-after delicacy all over the world. The more popular species found in Nigeria *Archachatina marginata* and *Achatina achatina* are characterized by high feed conversion rates (Omole *et al*., 2000). Snails are found in a variety of habitats which include fresh water, ponds and land. Snails thrive well in both temperate and tropical regions. Snail's soil tolerance differs, some prefer soils of low pH values (4-5) while most prefer slightly alkaline soils with pH ranges between 7.0 and 8.9 (Ejidike 2002).

Several studies have been carried out on the growth performance of the matured snail. Little attention has been paid to the micro-habitat of the snails and the effect of their immediate surroundings on the hatchability of its eggs and the subsequent performance of the hatchlings.

This study looks at the effect of some selected micro-habitats on the hatchability of the eggs of *Archachatina marginata*; the study also looks at how these selected micro-habitats could affect growth responses of the hatchlings. The study also seeks to identify suitable materials for the purpose of rearing snails on a household basis or the suitability of these micro-habitats for intensive rearing of snails on a commercial basis.

## Materials and Methods

This study was conducted over a period of six (6) months, at the snail unit of the Delta State University Asaba Campus Research and Teaching Farm ($6^0$14' N and $6^0$ 49'E). Twenty breeder snails of the species Archachatina marginata with an average weight of 143.9 g were purchased from Songhai Amukpe, a farm settlement in Sapele Local Government Area of Delta State Nigeria and were kept under intensive care with provision of feed and water ad lib for one month in order to obtain the experimental eggs. Feed used for the over-all duration of the experiment was *Carica papaya* (ripe paw-paw). The proximate composition of the diet is given in Table 1 below. A total number of one hundred and five (105) eggs were collected from the breeder snails and were placed in the selected micro-habitats. A total of twenty-one (21) eggs were placed in each of the selected micro-habitats which include top soil, river sand, mud, sawdust and decayed vegetation. The experimental eggs were replicated three times in a complete randomized design with seven (7) eggs per replicate. After separating the eggs from the breeder snails, they were weighed and measured to obtain the initial weights and lengths before placing them in the selected micro-habitats. The eggs were weighed and measured twice weekly until hatching took place. On hatching, the hatchlings were transferred to fresh media of the selected experimental materials and fed ad lib for a period of ten (10) weeks and housed in boxes built with ply wood and provided with wire mesh coverings to prevent escape. The boxes were rectangular in shape and had the same dimensions. The boxes were filled with the experimental materials to a depth of eight (8) inches. The micro-habitats were sprinkled with water once a day to prevent dehydration and were tilled once a week to loosen the materials for easy penetration of the left over feed, sand and snailet droppings.

Data collected include egg weight, egg length, total number of eggs hatched per micro-habitat and average daily weight gain of the hatchlings. Measurements were made using an electric beam balance and a tape rule. Hatched eggs were counted visually and estimated as a percentage of total number of eggs per micro-habitat. The data collected were subjected to a one-way analysis of variance, using IRRISTAT for windows (version 5.0) computer software. Means were separated using Duncan's Multiple Range Test procedures (Duncan 1955) and values were accepted at 5% probability.

## Results and Discussion

The choice of feeding materials used in this study is based on available information that snails can utilize a number of feeding materials for growth (FAO, 1985). Moisture content of snails feed is usually very high because of the method of feeding by snails which prefer feed in fluid form. The feed used in this experiment (ripe paw-paw) is very well tolerated by snails and several studies have shown a preference for this material by snails (Ejidike 2007; Siyanbola 2008). Analysis of variance of egg weight and egg length is shown in Table 2. Results show significant ($P<0.05$) differences between the groups with regards to egg length and egg weight. Results in Table 3 reveal that eggs placed in sawdust, mud and decayed vegetation had significantly ($P<0.05$) higher egg weights and egg lengths than eggs placed in top soil and river sand. There were no significant ($P>0.05$) differences in egg weight of eggs placed in sawdust and top soil, however significant ($P<0.05$) differences exist in egg lengths of these two groups.

Results of percentage hatchability measurements of the eggs of *Archachatina marginata* as affected by the different micro-habitats is given in Table 4. Results show significant ($P<0.05$) differences between the groups. Table 5 shows 100% hatchability for top soil and river sand, 95% hatchability for mud and decayed vegetation and 71% hatchability for sawdust.

Analysis of variance of hatchling weights over a period of ten (10) weeks is presented in Table 6. The results show bi-weekly significant ($P<0.05$) differences in weights between the groups. Table 7 shows the bi-weekly variation in hatchling weights over the ten (10) week period as affected by the different micro-habitats. Results show significantly ($P<0.05$) higher values for river sand and top soil by the second week, while lower values were recorded for decayed vegetation and mud. There were however no significant ($P>0.05$) differences between the groups in the fourth week. Significantly ($P<0.05$) higher values were recorded for sawdust and top soil by the sixth ($6^{th}$) week, with mud recording the lowest values. By the eighth ($8^{th}$) week, there were significant ($P<0.05$) differences between the groups, with sawdust showing significantly ($P<0.05$) higher values than the other test materials. By the tenth week sawdust recorded the highest values while top soil recorded the lowest values.

Table 8 shows the analysis of variance in bi-weekly body weight gain over a period of ten (10) weeks. Results reveal significant ($P<0.05$) differences in body weight gain between the groups during the first two weeks. There were no significant ($P>0.05$) differences in body weight gains between the groups from the fourth ($4^{th}$) to eighth ($8^{th}$) week. However between the eighth ($8^{th}$) and tenth ($10^{th}$) week, significant ($P<0.05$) differences in body weight gains between the groups were recorded. Table 9 shows body weight gain over the ten (10) week period. The table shows significant ($P<0.05$) differences in body weight gain over the ten (10) week period, with mud and sawdust recording the highest weight gains.

## Conclusion

Various micro-habitats may be used for the rearing of snails, depending on the suitability and availability of such-microhabitats. The present study has shown that top soil and river sand are good micro-habitats for the hatching of the eggs of the giant African snail *Archachatina marginata*. However for subsequent growth of the hatchlings, these micro-habitats may not be adequate for growth as revealed by the present studies. The present studies have shown that sawdust which is not a suitable material for hatching is unexpectedly a better micro-habitat for the growth of the hatchlings. It is

recommended that when considering an investment in heliculture, attention should be paid to the micro-habitat chosen for hatching the eggs and subsequent growth of the hatchlings.

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***Appendix***

**Table 1: Proximate composition of the experimental diet**

| Component | % |
|---|---|
| Moisture | 53.17 |
| Ash | 1.20 |
| Ether extract | 0.33 |
| Crude fiber | 11.50 |
| Crude protein | 1.02 |
| Calcium | 0.15 |
| Magnesium | 0.60 |

**Table 2: Analysis of variance: Egg weight and egg length**

| | | S S | df | MS | F | Sig (5%) |
|---|---|---|---|---|---|---|
| **Egg weight** | **Between groups** | 1.500 | 4 | .375 | 3.857 | .006 |
| | **Within groups** | 9.726 | 100 | .097 | | |
| | **Total** | 11.226 | 104 | | | |
| **Egg length** | **Between groups** | .923 | 4 | .231 | 12.342 | .000 |
| | **Within groups** | 1.870 | 100 | | | |
| | **Total** | 2.794 | 104 | | | |

SS: Sum of squares, df: Degree of freedom, MS: Mean Square

**Table 3: Post Hoc Tests: Egg weight and egg length**

| | Treatments | N | Subset for alpha = 0.05 | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| **Egg weight** | **River sand** | 21 | 3.4933[a] | | |
| | **Top soil** | 21 | 3.5481[a] | 3.5481[ab] | |
| | **Sawdust** | 21 | | 3.7205[bc] | 3.7205[c] |
| | **Mud** | 21 | | | 3.7505[c] |
| | **Decayed vegetation** | 21 | | | 3.7990[c] |
| | **Sig.** | | .574 | .076 | .447 |
| **Egg length** | **River sand** | 21 | 2.2619[a] | | |
| | **Top soil** | 21 | | 2.3667[b] | |
| | **Sawdust** | 21 | | | 2.4762[c] |
| | **Mud** | 21 | | | 2.4905[c] |
| | **Decayed vegetation** | 21 | | | 2.5095[c] |
| | **Sig.** | | 1.000 | 1.000 | .462 |

Means for homogenous subsets are displayed

**Table 4: Analysis of variance: Percentage hatchability as affected by micro-habitat.**

| | SS | df | MS | F. | Sig. (5%) |
|---|---|---|---|---|---|
| **Between groups** | 1714.476 | 4 | 428.619 | 6.300 | .008 |
| **Within groups** | 680.395 | 10 | 68.039 | | |
| **Total** | 2394.871 | 14 | | | |

SS: Sum of squares, df: Degree of freedom, MS: Mean Square

**Table 5: Post Hoc Tests: Percentage hatchability as affected by micro-habitat**

| Treatments | N | Subset for alpha = 0.05 | |
|---|---|---|---|
| | | 1 | 2 |
| Sawdust | 3 | 71.4267[a] | |
| Decayed vegetation | 3 | | 95.2367[b] |
| Mud | 3 | | 95.2367[b] |
| Top soil | 3 | | 100.000[b] |
| River sand | | | 100.000[b] |
| Sig. | | 1.000 | .524 |

**Table 6: ANOVA: Hatchling weights over a 10 week period**

| Hatchling weight | SS | dF | MS | F | Sig (5%) |
|---|---|---|---|---|---|
| Week 0 | | | | | |
| Between groups | .201 | 4 | .050 | .523 | .719 |
| Within groups | 9.601 | 100 | .096 | | |
| Total | 9.802 | 104 | | | |
| Week 2 | | | | | |
| Between groups | 14.670 | 4 | 3.668 | 3.824 | .006 |
| Within groups | 95.900 | 100 | .959 | | |
| Total | 110.570 | 104 | | | |
| Week 4 | | | | | |
| Between groups | 5.756 | 4 | 1.439 | .715 | .584 |
| Within groups | 201.303 | 100 | 2.013 | | |
| Total | 207.059 | 104 | | | |
| Week 6 | | | | | |
| Between groups | 81.157 | 4 | 20.289 | 4.648 | .002 |
| Within groups | 436.480 | 100 | 4.365 | | |
| Total | 517.637 | 104 | | | |
| Week 8 | | | | | |
| Between groups | 32.334 | 4 | 8.083 | 1.437 | .227 |
| Within groups | 562.568 | 100 | 5.626 | | |
| Total | 594.902 | 104 | | | |
| Week 10 | | | | | |
| Between groups | 288.503 | 4 | 72.126 | 8.549 | .000 |
| Within groups | 843.670 | 100 | 8.437 | | |
| Total | 1132.173 | 104 | | | |

**Table 7 Post Hoc Tests: Bi-weekly variation in hatchling weights as affected by micro-habitat (10 week period).**

| | River sand | Sawdust | Decayed vegetation | Top soil | Mud |
|---|---|---|---|---|---|
| Week 0 | 2.0138 | 2.0233 | 2.0767 | 2.1014 | 2.1267 |
| Week 2 | 4.8090[a] | 4.2995[ab] | 3.9767[b] | 4.7219[a] | 3.8938[b] |
| Week 4 | 5.4600 | 5.6433 | 5.2614 | 5.9714 | 5.6205 |
| Week 6 | 6.9805[ab] | 8.2390[a] | 7.2043[a] | 8.0757[a] | 6.7905[b] |
| Week 8 | 8.7843[b] | 10.5167[a] | 9.4214[ab] | 9.5157[ab] | 9.5148[ab] |
| Week 10 | 12.7019[b] | 16.0814[a] | 14.6481[a] | 11.6514[b] | 15.3500[a] |

Means for groups in homogenous subsets are displayed

**Table 8: ANOVA: Bi-weekly variations in body weight gain**

| Body weight gain | SS | df | MS | F | Sig. (5%) |
|---|---|---|---|---|---|
| 0-2 weeks | | | | | |
| Between groups | 2.401 | 4 | .600 | 3.498 | .049 |
| Within groups | 1.716 | 10 | .172 | | |
| Total | 4.117 | 14 | | | |
| 2-4 weeks | | | | | |
| Between groups | 1.980 | 4 | .495 | .928 | .486 |
| Within groups | 5.337 | 10 | .534 | | |
| Total | 7.318 | 14 | | | |
| 4-6 weeks | | | | | |
| Between groups | 10.190 | 4 | 2.547 | 1.454 | .287 |
| Within groups | 17.514 | 10 | 1.751 | | |
| Total | 27.704 | 14 | | | |
| 6-8 weeks | | | | | |
| Between groups | 9.057 | 4 | 2.264 | .979 | .461 |
| Within groups | 23.130 | 10 | 2.313 | | |
| Total | 32.187 | 14 | | | |
| 8-10 weeks | | | | | |
| Between groups | 28.043 | 4 | 7.011 | 2.496 | .110 |
| Within groups | 28.091 | 10 | 2.809 | | |
| Total | 56.134 | 14 | | | |
| 0-10 weeks | | | | | |
| Between groups | .403 | 4 | .101 | 6.922 | .006 |
| Within groups | .146 | 10 | .015 | | |
| Total | .549 | 14 | | | |

**Table 9 Post Hoc Tests: Variation in body weight gain (0-10 weeks)**

| Treatments | N | Subset for alpha = 0.05 | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Top Soil | 3 | .95500[c] | | |
| River sand | 3 | 1.06933[c] | 1.06933[bc] | |
| Decayed vegetation | 3 | | 1.23067[b] | 1.23067[ab] |
| Mud | 3 | | | 1.31933[a] |
| Sawdust | 3 | | | 1.40567[a] |
| Sig | | 1.000 | .524 | .426 |

Means for homogenous subsets are displayed