**EFFECTS OF POPULATION DENSITY ON THE GROWTH AND EGG-LAYING
CAPACITY OF THE AFRICAN GIANT LAND SNAIL,
Archachatina marginata (Swainson)
RAISED IN CAPTIVITY**

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ABSTRACT

The effects of the population density of adult African giant land snail, *Archachatina marginata* on the egg-laying capacity and the growth of the brooders and hatchlings were investigated for 9 months. Ten culture pens were stocked with snails at 20%, 40%, 60%, 80% and 100% capacity with each group in 2 replicates. Average weight gain of brooders was highest in pens stocked at 40% population density while the lowest was in pen stocked at 100%. Average number of eggs laid per snail and average number of eggs per pen followed the same trend in the study. The highest average number of eggs laid per pen was obtained in pens stocked at 60% population density (586) while the least was from pens at 20% population density. The result was same for average number of eggs laid per snail i.e. 7.5 eggs in pens stocked at 60% and 4.1 eggs in pens stocked at 20%. There was no significant difference in the weights of hatchlings in the different pens.

Key words: African giant land snail, population density, egg laying capacity, captivity.

INTRODUCTION

The behaviour of animals in confinement or captivity has been widely discussed (Warwick, 1987, 1990, Elmslie, 1992). There is the notion that the normal behaviour of animals put under confinement are suppressed when their social structures and environments are altered by management procedures. Some studies however do not establish any complete loss of certain behavioural patterns that accompany transition from the wild to the domesticated state (Craig 1981., Price, 1984). Different behavioural aspects have been studied in ducks, pigs and sheep placed under some degrees of confinement (Grubb, 1974, Desforges & Wood-Gush, 1976, Stolba, 1982) most of which are man's common source of animal protein. In tropical West Africa, the African giant land snail, *Archachatina marginata* a popular source of 'bush-meat'. In the rain forest of the

Southwest of Nigeria, it is a delicacy that is relished and highly priced. It is collected from the litters and burrows of cocoa and banana plantation, where it supports a viable economy among peasant farmers who sell them along major roads.

The snail has been found to about 88.3% (dry wet basis) of protein (Imevbore & Ademosun, 1988) with its dry matter consisting of lysine, leucine isoleucine and phenylalanine (BEDIM, 1993). In Nigeria, large scale commercial rearing of *A. marginata* has been initiated by various local and international bodies especially BEDIM, Italian Snail Farmers Association, International Foundation of Science, Federal Economic Advancement Programme (FEAP) and Poverty Alleviating Scheme. Thus commercial rearing of *A. marginata* has been advocated.

A number of edible land snails have been known to be reared. However in the southern part of Nigeria where snails are more common, two species stand out for consumption because of their acceptability and availability. These are the *Archachatina marginata* and the *Achatina achatina* Akinnusi (1998) showed that the former specie, due to its large size was better favoured for culture than the latter. Among the advantages cited for its farming include, (a) high potential for huge returns with low input, (b) cheap feeding and locally available feeding materials and (c) regular availability of fresh snails throughout the year to replenish stock.

The main objective of this paper is to investigate the effects of population density on the egg-laying capacity and the growth-and-survival rate of the African giant land snail raised in captivity.

MATERIALS AND METHODS

This study was carried out between April and December 1997 for a total of 275 days. Ten (10) culture pens (180cm x 60cm x 60cm) were constructed to house the experimental snails. Each pen has a netted body, wooden floor with a layer of loamy soil of about 15cm thick. 780 mature snails

were purchased from local farmers within the Abeokuta environment.

As their ages could not be determined, the whorls of the shells were used as an estimate of age in selecting the snails to be bought. Those selected had at least five complete whorls, which is an indication of sexual maturity (Phillips, 1992).

Five groups of snails were allotted at random to ten pens at a population of 20%, 40%, 60%, 80% and 100% of the total culture area (Table 1).

TABLE 1: ALLOTTMENT OF EXPERIMENTAL SNAILS TO PEN AT DIFFERENT POPULATION DENSITIES

Pen no	Population % per total unit area	Snail population
1	60%	78
2	20%	26
3	80%	104
4	100%	130
5	40%	52
6	20%	26
7	40%	52
8	80%	104
9	100%	130
10	60%	78

Feeding and watering of the animals were done every evening, since they are known to be active feeders in the night (Phillips, 1992). Feeds given include green fruits and leaves of pawpaw, leaves of amaranthus and pulverised maize shaft. Feeding was usually *ad libitum*. Water used was from a borehole. All feeds were cut into smaller pieces to encourage direct consumption.

The following data were collected.

(i) Egg-laying capacity i.e. number and dates of laying, emergence of hatchlings and monthly weights of brooders; measurements of the sizes of

the snails were done using a linen tape, while the weights were taken using a sensitive electronic weighing machine.

(ii) Weights of the adults during the experimental period were also taken. Other data such as soil temperature, sunshine, ambient air temperature, relative humidity were also obtained. Data collected were subjected to one way analysis of variance using the computerised Statistical Analysis System, SAS (Barr et al., 1976).

RESULTS AND DISCUSSION

The growth response of the adult African giant land snail within the experimental period is presented in Table 2. The average initial live weights of the snails ranged between 225.1 gm and 281 gm. By the end of the study this has increased to an average of between 341.3 gm and 389 gm. The mean weight gain was highest in treatment 2 (116.5 gm) that was stocked at 40% population density. The lowest mean weight gain was recorded in treatment 5 with 100% population density of snails. This shows an increase in weight between 25% and 29%. This is an indication that snails can and do grow in captivity provided they are well fed. Growth values obtained agree with Awah (1992) carried out at the Rubber Institute, Benin. In this work, snails raised in at the Rubber Institute in Benin under controlled situation showed increase in weight ranging between 30% and 35%.

Figure 1 shows a decrease in average weight gain of the adult snails as the population per unit area increases. In spite of the fact that all the adult snails were fed the same type of feeds *ad libitum*, the highest average weight gain was obtained in pens with 40% population per unit area, while the lowest

TABLE 2: WEIGHT GAIN OF THE ADULT AFRICAN GIANT LAND SNAIL (*A. MARGINATA*) MANAGED UNDER DIFFERENT POPULATION DENSITY FOR 6 MONTHS

	SNAIL POPULATION DENSITY ¹					SEM ³
	1(20)	2(40)	3(60)	4(80)	5(100)	
Average snail number/pen	26	52	78	104	130	
Total snail number/treatment	52	104	156	208	260	
Mean initial weight (gm)	225.1 ^a	272.6 ^a	269.4 ^a	274.2 ^a	281 ^a	3.43
Mean final weight (gm)	359.7 ^a	389 ^a	350 ^a	344.6 ^a	341.3 ^a	2.69
Mean weight gain (gm)	104.6 ^{ab}	116.5 ^a	80.6 ^{ab}	70.4 ^b	60.3 ^b	0.68
Specific growth rate (%) ²	0.014 ^a	0.012 ^a	0.008 ^a	0.007 ^a	0.006 ^a	0.001

a,b, = Values in the same row having the same letter are not significantly different ($P > 0.05$)

1 = Snail population stocked at different capacity (density)

2 = Specific growth rate (SGR) = $\log_e W_2 - \log_e W_1$ divided by $T_2 - T_1$ where W_1 is weight at time T_1 and W_2 is the weight at T_2

3 = Standard error of the pooled means

POPULATION DENSITY VS GROWTH AND PRODUCTIVE CAPACITY OF *ARCHACHATINA MARGINATA* IN CAPTIVITY

TABLE 3: EGG-LAYING AND HATCHING RECORDS OF THE YOUNG OF *A. MARGINATA* RAISED UNDER DIFFERENT POPULATION DENSITY.

Pen no/ population density	No of eggs Laid and collected ¹	No of baby Snails hatched ²	% hatchability	Incubation period	Eggs/batch
1(60)	601	534	89.0	29	8
2(20)	193	174	90.0	29	10
3(80)	557	463	83.1	30	9
4(100)	539	401	74.6	29	10
5(40)	304	272	89.5	31	10
6(20)	189	170	98.7	31	11
7(40)	325	286	88.4	30	10
8(80)	533	441	82.8	31	9
9(100)	537	394	73.4	30	9
10(600)	568	491	86.5	31	8

1=Raw data of all eggs collected per pen and pooled for the whole experimental period

2=Raw data of all snails hatched per pen pooled for the entire experimental period.

was obtained in pens stocked at 100%.

The egg laying and hatching records are presented in Table 3. Laying started a few days after stocking. The eggs were laid in batches inside the soil. The number of eggs per batch ranged between 8 and 11. This phenomenon is similar to the FAO (1986) report on *A. marginata*. In each pen, the number of eggs were counted and collected for incubation every month. At the end of the experimental period of 275 days all data of collected eggs per pen were added (pooled) together as total number of eggs laid and collected.

The incubation period ranged from 29 to 31 days across the months of the experiment. Percentage hatchability of the eggs varied from 73.4 to 98.7% with a mean of 84.6%. However the highest percentage occurred in pens stocked at 20% population density. This was followed by pens stocked at 40%. The least hatchability was from pens stocked at 100% population density, this

may be due to over crowding and probably environmental stress. Agbelusi & Ogunlade (1992) observed that egg hatchability is environmentally induced.

Figure 2 shows the average number of eggs laid per snail and the average total number of eggs laid in the different pens. The highest (585) was recorded in the pens stocked at 60% population density, followed by those of 80% (545) and the least, 20% (191). Similarly the average number of eggs laid per snail was computed. The result shows that the highest was recorded in pens stocked at 60% (7.5) followed by 40% population density (6.1). The least average number of eggs per snail was recorded from both 20% and 100% population density (4.1 each).

From the above it follows that egg-laying capacity of the snails was adversely affected under a very high population density. This was probably due to overcrowding and lack of space for the adult

TABLE 4: MEAN WEIGHTS OF YOUNG SNAILS (*A. MARGINATA*) RAISED UNDER DIFFERENT POPULATION DENSITIES

Pen no (pop. density)	Mean weight at hatching (g)	Mean weight at 2 months (g)	Mean weight at 4 months (g)	Mean final weight at 6 months(g)
1(60)	2.3	12.6	25.8	31.4
2(20)	2.3	13.8	27.5	32.3
3(80)	2.4	14.4	26.6	34.6
4(100)	2.2	14.6	28.4	32.8
5(40)	2.1	13.9	26.8	31.6
6(20)	2.3	14.8	27.3	30.8
7(40)	2.4	14.6	26.9	31.4
9(80)	2.4	14.7	25.3	31.6
9(100)	2.3	14.8	24.8	30.3
10(60)	2.2	14.8	24.9	31.3

Figure 1: Weight trends of African giant land snail raised under different population rate.

Figure 2: Average number of eggs laid per snail and the average number of eggs laid in the different pens stocked under varying population density.

TABLE 5: MEAN WEIGHTS OF YOUNG SNAILS (*A. MARGINATA*) RAISED UNDER DIFFERENT POPULATION DENSITIES.

	Snail population density					
	1(20)	2(40)	3(60)	4(80)	5(100)	SEM
Mean weight at hatching (g)	2.3	2.3	2.3	2.4	2.3	0.05
Mean weight at 2 months (g)	14.3 ^a	14.3 ^a	13.7 ^a	14.6 ^a	14.7 ^a	0.09
Mean weight at 4 months (g)	27.4 ^a	26.9 ^a	25.4 ^a	26.0 ^a	26.6 ^a	1.05
Mean weight at 6 months (g)	31.6 ^a	31.5 ^a	31.4 ^a	33.1 ^a	31.6 ^a	1.55
Weight gain at 6 months (g)	29.3 ^{ab}	29.2 ^b	29.1 ^a	30.7 ^{ab}	29.3 ^b	1.02
Specific growth rate (%)	0.015	0.014	0.014	0.015	0.015	0.002

snails to rest (hibernate) and lay their eggs. The pens that were stocked at 60% population density had the highest values (eggs laid/snail and total eggs laid). This is probably due to the prevailing highly favourable environmental conditions in the pens as a result of adequate 'living space' or 'niche' per snail.

Table 4 shows the growth response as shown by mean weights of the young snails during the study period. The study shows that the rate of growth of the young snails is rather very slow. With a mean live weight of 2.3 g at hatch and an average length of 15mm, the snails were only able to weigh on the average 34.6g at 6 months. The final mean length was 46.3mm. The slow growth rate of young snails had been mentioned by different authors (Awesu 1988, Awah, 1992). This also agrees with FAO (1986) that shows that snails, *A. marginata* were able to grow between 90 to 130 mm at maturity. It can thus be concluded from this study that the slow growth rate expressed by the young snails is not likely due to the different population densities.

The raw data in table 4 was statistically analysed and tested using ANOVA as shown in Table 5. The highest mean weight gain was recorded in pen 5 (80%) however there was no significant difference ($P > 0.05$) between all the pens.

The present study has demonstrated that *A. marginata* can be reared successfully and profitably with due and proper attention to the appropriate population density of the adult snails in the culture medium. A 60 per cent space utilization is found to be the most desirable for maximum egg-laying and consequent hatching. Mortality is shown to be generally low thus snail-rearing can be a promising and profitable protein-production venture.

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