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EFFECTS OF LAND-USE ON THE DECLINE OF THE AFRICAN GIANT SNAILS IN OWERRI, SOUTH-EASTERN NIGERIA

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ABSTRACT
Snail population densities and biomass were investigated in different land-uses in Owerri, south-eastern Nigeria. The results indicate that the more the intensity of land –use, the less the population density and biomass of land snails. The snail population density of 25,000/ha and biomass of 0.632 tonnes/ha in primary forest were significantly (P< 0.05) higher than in the other land-use forms, namely, 4-year fallow, plantain field, home garden and open grassland. Also, giant land snails in primary forest were significantly (P < 0.05) larger-sized than in the other land-use forms. Though the low population densities and biomass noted in this study are not representative of the values in the more forested regions of southern Nigeria, the low values are however indicative of the future trends in snail supplies as more primary forests are converted to farmlands. Promotion of snail farming is suggested as a likely mitigation option to replenish over-exploited wild stocks of giant land snails.
Key words: *Biomass, giant snails, land-use, Nigeria, primary forest.*

INTRODUCTION
Animal protein intake in Nigeria continues to fall short of recommended minimum. According to Udedibie (2000), the daily per-capita animal protein intake of Nigerians, estimated at 8.5g in 1968, declined to 6.5g in 1980, 6.0g in 1983 and 5.0g on 2000. These values, which represent 14-24% of the recommended minimum daily intake of 35g, appropriately reflect the critical animal protein shortages in Nigeria. One of the major reasons for the decline in animal protein intake in Nigeria is the high growth rate of the human population resulting in increased demand for protein products and more pressure on grazing resources as more land is brought under cultivation. For some time, there has been some interest in developing other so-called non conventional protein sources such as the giant African land snails.

The potential of edible land snails as sources of protein
Various species of land snail constitute an important protein source in the diets of inhabitants of West Africa. The two genera of edible land snails in West Africa are *Achatina* and *Archachatina*, generally referred to as giant land snails or giant African land snails. Both genera show preference for primary rainforest and moist secondary growth. Although Bequaert (1950) estimated the number of valid species of *Achatina* at between 65 and 80, the common species in the rainforest belt of West Africa are *Achatina achatina*, *A. monochromatica* and *A. balteata* (Hodasi, 1984). Similarly, there are three species of

Archachatina in West Africa, namely, *A. marginata, A. degneri* and *A. vetricossa. Of* these three species, only *A. marginata* is found in Nigeria.

In Nigeria the main edible land snail is *Archachatina marginata.* It is hard to find any urban or rural market in southern Nigeria without large quantities of the land snail *A. marginata* displayed for sale. The common size ranges of market samples of giant snails are shell length 70mm - 130 `mm, weighing 75g -360g. Exceptional large specimens can attain a shell length of up to 165 mm and weight of 570g. Generally, about 33.0 % of total weight is edible meat. Apart from being a highly valued protein source, snail meat also has profound cultural and medicinal values. Traditionally, in many parts of eastern Nigeria, snail meat is a compulsory item in the diet of nursing mothers. Also, Osemeobo (1992) listed 15 health conditions that are believed to be curable with the meat, fluid and shell of Africa giant snail. Giant land snails are collected throughout the year from forests and moist secondary growth of bush. Most previous studies on natural snail populations fell short of giving records of snail biomass. Mead (1982) reported that *Achatina fulica* is capable of attaining a comparatively remarkable biomass within a few months. The work however did not provide actual figures of this biomass. Adeola and Decker (1987) estimates of number of snails collected by farmers in the deciduous forest region of Nigeria are only marginally indicative of the snail productivity in the region. Similarly, Mead and Palcy (1992) reported extraordinarily heavy infestations of *Achatina fulica* in French West Indies but without specific mention of the population densities. Abbes and Singh (1975) provided information on snail densities but not biomass. Only a few works like Kekauha (1966) provide some data on snail biomass

OBJECTIVES OF STUDY

The objectives of this paper are threefold:

to do a comparative estimate of snail biomass in a primary rainforest and other land-use practices in Owerri, south eastern Nigeria.

to assess the impact of land-use patterns on snail populations based on these estimates; and

to make predictions on future snails supplies.

MATERIALS AND METHODS

Study site

The sampling stations were located in Owerri and environs, situated at about longitude $07^{0}02$`E – $21^{0}45$`E and latitude $05^{0}40$` N – $55^{0}85$`N which falls within the tropical rainforest zone of Nigeria. The two major seasons in the area are the dry season (October-March) and a rainy season (April-September). Soil conditions at the sampling stations can be described as well-drained, acidic, sandy loam (Enwezor *et al* 1981).

Sampling

Sampling was done in the months of February-April, 2003, which fell within the end of the dry season and onset of the early rains when most of the land snails were generally ending aestivation. Ten (10) sample plots measuring 2m x 5m were randomly chosen in each of

the following habitats: (a) primary rainforest (b) 4-year fallow farmland (c) plantain field (d) home garden and (e) open grassland.

Census was by total count of all snails in the 50 plots. This was achieved by collecting all snails on vegetation as well as combing the snail within 5.0 cm depth to collect both resting and aestivating snails. Shell lengths and individual weights of the snails were measured. The shell length was taken as the longest vertical axis of the shell, measured from the tip of the spire to the basal edge of the outer lip. Based on the longest shell length (SL) of 102.0mm obtained in the samples, the snails were sorted into two size classes: small snails (<50 mm SL) and large snails (50 mm SL).

Statistical Methods

The mean snail density and mean snail biomass in each land-use were calculated from pooled data from all the 10 plots in each land-use. Snail densities were expressed in numbers/hectare while biomass was presented in kg/hectare. Significant differences in this study were mainly investigated by analyses of variance tests. When there were significant differences, the various means were separated using the least significant differences (LSD) test as outlined by Steel and Torrie (1980).

RESULTS

Snail biomass in different land-use

Table 1 compares snail biomass in the different land-uses. Primary forest had the highest snail biomass of 532.5 kg/ha. This was followed by 189.0kg/ha for 4-year fallow, 106.1kg/ha for plantain field, 74.9kg/ha for home garden and 322.9kg/ha for open grassland. Snail biomass in primary forest was significantly ($P< 0.05$) higher than in open grassland. There was no significant difference ($P>0.05$) in the snail biomass of plantain field, home garden and open grassland.

Snail population density

Primary forest had the highest snail population density of 25,000/ha followed by 21,000/ha in 4-year fallow, 13,100/ha in plantain field, 9600/ha in home garden and 5400 in open grassland. These differences in population densities between the land-uses were significantly ($P< 0.05$) different (Table 2).

Species composition of snails

The only species of Africa giant snail identified in the study was *Archachatina marginata* which consisted of four subspecies, namely, *Archachatina marginata marginata, A.m suturalis, A.m grevillei* and *A.m. eduardi* based on descriptions of Bequaert (1950). Apart from the giant snail, there were also some garden snail, dominated by the garden snail *Limicolaria* spp which displayed considerable polymorphism and polychromatism. For the purpose of this study, the snails were categorized into giant land snails and garden snails.

Primary forest, 4-year fallow and plantain field had predominantly more giant land snails while home garden and open grassland had more garden snails (Table 3). Giant land snails made up 95.2% of snail population density in primary forest, 83.4% in 4.year fallow and 92.7% in plantain field. On the other hand, giant land snails made up only 29.6% of snail numbers in home garden and 10.2% of snail numbers in open grassland.

Size composition of snails

The largest specimen collected during this study was a giant land snail *Archachatina marginata* subspecies m*arginata* which had a shell length (SL) of 102.0mm and a weight of 125.0g. The smallest specimen was an *A. marginata* subspecies *eduardi* with 23.0 mm SL and weight of 5.5g. Table 4 describes the relative abundance of small snails (< 50mm SL) and large snails (50 mm SL). Primary forest had a greater proportion of large sized snails than other land –uses. Large sized snails made up 67.4%.

DISCUSSION

The snail population densities and biomass recorded in these studies are comparatively low. The snails in this study were also comparatively smaller-sized, considering that the largest snail was only 102.2mm SL long when market samples outside the region commonly show specimens of over 150mm SL. Though the samples were taken towards the beginning of the rainy season, when the snails were generally still recovering from low metabolic activity and weight loss as a result of prolonged aestivation during the dry season, this factor alone cannot explain the pronounced low snail population density and low biomass observed in the study. Another likely explanation is the over-harvesting of the snail populations. Snail meat is highly popular in the study area. This, coupled with a high human population of over 320 persons/Km^2 (FOS, 1999), implies a high hunting pressure for the snails as well as more intensive land-use for agriculture, which may degrade the natural habitats of the snails.

The pronounced disparity in the snail population densities, biomass and size composition in the different land-uses is not surprising. Primary forest, which had not been subjected to any form of agricultural activity, has higher population densities, higher biomass and larger-sized snails than the other land-uses. Land preparation for agriculture in the study area usually involves land clearing and bush burning. All but a small fraction of the snails perish during land preparation for agriculture. With more intensive land-use involving shorter fallow periods and use of inorganic fertilizers and pesticides, conditions become less favourable for giant land snails resulting in an upsurge in the percentage composition of garden snails which are probably more adaptable to adverse conditions.

Future tends in snail supply in Nigeria

The low biomass of this study area is indicative of the future trends of events in snail supplies in Nigeria. If human population growth rate continues at the present rate, more

forests will have to be cleared to make way for farmlands. Snail populations that survive in the farmlands are further depleted by bush burning and use of pesticides.

Osemesobo (1992) had already noted a decline in snail supplies for the past few decades. The decline will likely continue in terms of snail population density, biomass and individual sizes of snails in Nigeria. Also, there will be pronounced change in percentage composition of species and subspecies of land snails. As more and more forests degrade to short fallow farmlands, there will be a rise in percentage composition of the more hardy garden snails. Even among the giant snails, there will be a prominence in the numbers of *A marginata* subspecies *eduardi,* a smaller-sized, earlier maturing and faster reproducing (Okorie and Okere 1994) subspecies of African giant snails. Preliminary observations in this study already show substantial spatial overlap in the distribution of this subspecies and the garden snails.

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Table 1 Biomass and numbers of snails in different land-uses

Land-use	Biomass/ha (Kg)	Numbers/ha
Primary Forest	532.5[a]	`25,000[a]
4-yr fallow	189.0[b]	21,000[b]
Plantain field	106.1[bc]	13,100[c]
Home garden	74.9[bc]	9,600[d]
Open grassland	32.9[c]	5,400[e]

a, b, c, d, e Means within a column with different superscripts are significantly different (P<0.05)

Table 2 Number of large and small snails in different land-uses.

	No. of snails/ha (Mean ± S.E)	
Land-use	Large snails	Small snails
Primary forest	16,700 ± 400[a]	8,200 ± 610[b]
4 – yr fallow	6,300 ± 590[b]	15,200 ± 620[a]
Plantain field	3,400 ± 450[b]	9,600 ± 530[a]
Home garden	3,100 ± 310[b]	6,300 ± 380[a]
Open grassland	1,000 ± 230[b]	4,400 ± 340[a]

a, b Means within a column with different superscripts are significantly different (p< 0.05)

Table 3. Percentage composition of giant land snails and garden snails.

Land-use	Giant land snails (%)	Garden snails(%)
Primary forest	95.2	4.8
4.yr fallow	83.4	16.6
Plantain field	92.7	7.2
Home garden	29.6	70.4
Open grassland	10.2	89.8

Table 4 Size composition of snails in the land-uses

Land-use	Large snails (%)	Small snails (%)
Primary forest	67.4	32.6
4-year fallow	29.5	70.5
Plantain field	26.2	73.8
Home garden	33.7	66.3
Open grassland	19.1	80.9