



# Impact of the Gathering Pressure on Edible Snail's Population of a Classified Forest in the South of Côte d'Ivoire

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## To cite this article:

N'dri Saint-Clair Amani, Mamadou Karamoko, Coffi Franck Didier Adou, Atcho Otchoumou. Impact of the Gathering Pressure on Edible Snail's Population of a Classified Forest in the South of Côte d'Ivoire. *International Journal of Natural Resource Ecology and Management*. Vol. 1, No. 2, 2016, pp. 11-19. doi: 10.11648/j.ijnrem.20160102.11

Received: May 30, 2016; Accepted: June 12, 2016; Published: June 23, 2016

**Abstract:** An investigation was carried out in the department of Agboville with populations living near Yapo classified forest (Côte d'Ivoire) on the gathering of edible snails during the year 2015. This study aimed at first, to list various edible snails gathered by the bordering populations, then to identify actors of the gathering of these snails and finally, to evaluate the quantities collected in this forest. We used the method of direct observation, with slip of investigation. The results revealed that two edible snail species were collected by that population. The activity of gathering is mainly practised by men and farmers with respective proportions of 83% and 38%. The age of the gatherers varies from 8 to 50 years. The amount of snail collected was estimated to 13.60 tons for *Achatina achatina* and 1.69 tons for *Archachatina ventricosa*. The catches decreased considerably from 80 about 130 snails to 1 about 15 snails per day. Save measures must be taken for the conservation of this resource because of the pressure exerted on these animals.

**Keywords:** *Achatina achatina*, *Archachatina ventricosa*, Gathering, Yapo Classified Forest

## 1. Introduction

Annual consumption of edible snail in Côte d'Ivoire is estimated at 17 000 tons [13]. Abidjan recorded 830 tons of fresh snails and 69 tons of snails smoked in 1986 and more than 1 700 tons in 2008 sold on the market [7].

This supply decrease progressively. Moreover, in 2015 we recorded 300 tons of snails [16]. Snails' habitat destruction by deforestation, pesticides use, certain agricultural practices and bush fires constitute the principal causes. In added, the pressure of poaching related to marketing on large scale [11, 8]. Protected areas to which belong classified forests remain the only refuges. Unfortunately, despite of the protection measures, land snails are the object of anthropic pressure amongst other things the exaggerated poaching. It is fit to take appropriate measurements for management and protection of this resource. This decision could not be taken

without having a preliminary knowledge on gatherings' data of edible snails in our forests and in particular in protected areas. It would make possible a better evaluation of the anthropic pressure. The general objective of this study was to evaluate the collecting pressure on edible snails by the bordering populations. Specific aims were at first to list various edible snails gathered by these populations and then, to identify actors of the snail's gathering and finally, to evaluate the collected quantities of these animals in this forest.

## 2. Material and Methods

### 2.1. Study Area

The study proceeded in the bordering villages of Yapo classified forest. This forest is located in the South of Côte d'Ivoire, between (5° 40'- 5° 47' N, 4° 06'-4° 11' E (Figure 1).

The forest covers about 9000 ha and it's to 25 km in the South of Agboville and to 50 km in the North-East of Abidjan. The relief is less undulating with many low slopes of less than 5% [17]. The climate is subequatorial, with four distinct season: great rainy season (March-June), little dry season (July-August), little rainy season (September-November) and great dry season (December-February) [18]. The annual average rainfall varies to 1500 mm from 2100 mm with an annual mean temperature of 27°C [21]. The forest is located in a climax of dense forest wet sempervirens

characteristic of the ombrophilous sector of guinéen domain. The vegetation is secondary formation.

These villages are localised in Agboville department. According to the census of 2014 of National Institute of the Statistics, There is 1264 inhabitants at Aké-Béfiá, 2694 at Azaguié M'bromé, 1187 inhabitants at Elevi, 2413 inhabitant at Guéssigué I, 2359 inhabitants Guéssigué II, 4428 at Grand-Yapo and 4405 inhabitants at Petit-Yapo. The ethnic groups are: Abbey, Morés, Baoulés, Malinkés, Yacouba, Guéré etc. These people are mainly growers and tradesmen.

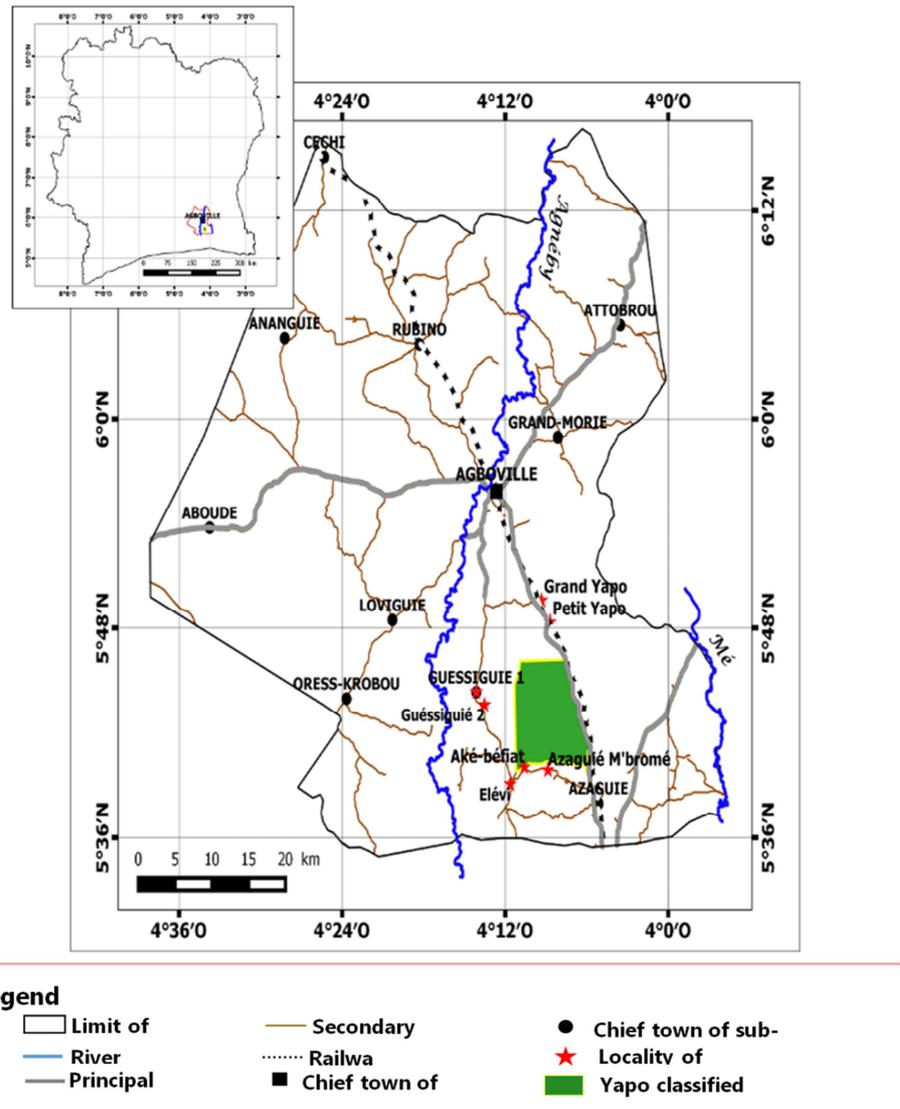


Figure 1. The location of Yapo classified forest and position of the surveyed villages.

**2.2. Material**

**2.2.1. Biological Material**

The biological material was the edible snail species coming from Yapo forest classified and gathered by the bordering populations.

**2.2.2. Technical Material**

A list of questions was elaborate to collect desired information. An electronic slide caliper (precision 0.05 mm)

and a spring scale (32 kg maxi) were used respectively for measurement the lengths of shells and to take weigh of snails' bags.

**2.3. Methods**

We used the method of direct observation, with slip of investigation. An exploratory preliminary investigation made to choose the localities, to prepare a questionnaire and to better orientate the study. The questionnaire was elaborated

according to objectives of study. The questions related sociogeographic characteristics, collecting of snail species, the quantities and the sizes of snails collected. The days of collecting and evolution of catches during two last decades were required.

Information were collected from the inhabitants choose randomly. We proceeded to questioning of each inhabitant until the manpower of sample. The survey was carried out in french. However, when the villagers not understand french an interpreter is solicited. Investigation slips were left near persons surveyed in order to inform them. They were recovered each month to evaluate the quantities of snails collected. This study proceeded during all the year 2015.

### 2.3.1. Surveyed Population

The people minimal size to inquire was fixed according to Dagnelie's formula [4]:

$$n = \frac{U_{1-\alpha/2} \times p(1-p)}{d^2}$$

Where N: Minimal size of people surveyed;

$U_{1-\alpha/2}$ : 1.96 (with  $\alpha$  = Level of precision 5%);

D: is the margin of error fixed at 0.08;

P: rate of survey 50%

Failing of preliminary base of survey, a survey rate to 50% was fixed. A sample of 384 people was made up with 26 people of Aké-Béfia, 55 people of Azaguié M'bromé, 24 people of Elévi, 91 people of Grand-Yapo, 49 people of Guéssiguié I, 48 people of Guéssiguié II and 90 people of petit-Yapo.

### 2.3.2. Estimate of Gathering

The collected quantities were estimated starting from the following formula:

$$QT = (Qjc) \times (Njm) \times \text{Number of month of gathering}$$

Where QT: Total quantity of gathered snails, Qjc: Number of snails Gathered per day, Njm: Number of days of gathering in the month and Nmc: A number of months of gathering.

Also, the snails were distributed by class of size for better appreciating the anthropic pressure [16]. Three classes were defined for *Achatina achatina*: "Small" (Length of shells lower than 8.5 cm), "Mean" (Length of shells ranging between 8.6 from 12 cm) and "Big" (Length of shells higher than 12 cm). Concerning *Archachatina ventricosa*, we also have "Small" (length of shell lower than 6.50 cm), the "Mean" (length of shell ranging between 6.6 and 8 cm) and the "Big" (length of shells higher than 8 cm). Shells of *Achatina achatina* with the sizes to 8.5 cm and 12 cm and *Archachatina ventricosa* with the sizes to 6.6 cm and 8 cm have presented to persons surveyed. What made possible to estimate the quantities collected per size. Ten snail bags of each class of size were weighed in order to determine the average weight of one bag. The dimensions of empty bags were: 0.8 m (length) and 0.5 m (breadth).

## 2.4. Statistical Analysis

The descriptive statistics were used for the data analysis. It consisted of calculations of sums, averages and proportions. The various proportions were subject of comparisons to  $\chi^2$  test. These calculations were carried out with software SPSS version 20. The average numbers of day of collection per month and the average quantities of snails Gathered per day collected by the various villages were compared by an analysis of variance (ANOVA 1) according to HSD test of Tukey using software SATTISTICA version 7.1.

## 3. Results

### 3.1. Gathered Species

Two species of snail were collected: *Achatina achatina* and *Archachatina ventricosa*. Among the surveyed populations, 60.70% collect only *Achatina achatina* while 39.30% collect the two species.

### 3.2. Sociogeographic Characteristics

The gathering of snails is practiced by the persons of two sex. However, the activity is strongly dominated by the sex masculine with a proportion of 83% among the 384 people, against 13%, for the female sex. It arises in addition that six (6) ethnic groups divided in two great groups practice this activity. The first group includes only Abbey with a large proportion of 87.50%. The second group which includes the five other ethnic groups (Baoulé, Malinké, Lobi, Moré and Yacouba) accounts for 17.50% of persons surveyed.

The gatherers practice various job: growers (38.3%), medicinal plants researchers (27.60%), housewives (13.30%) and people of other job (20.80%) composed by refrigerating technicians, coalmen, tradesmen and piscicultural employees.

Gatherers age varies between 8 from 50 years. The young people mainly composed by adults 1 (18 to 30 years) and adults 2 (30 to 40 years), are represented with respective proportions of 48.70% and 33.60%. The teenagers (10 to 18 years), adults 3 (40 to 50 years) and the children respectively account for 9.40%, 7.80% and 0.50% of the gatherers.

Concerning the educational level, 68% of persons surveyed have a primary education level whereas 21.10% have a secondary level and 10.90% are illiterate.

Among the whole of persons surveyed, 338 (88%) consume snail against 46 (12%) people who do not consume. Among consumers, 69.57% affirm that the snail is a taboo for them, 26.09% do not consume for cultural reasons and 4.34% for personal tastes.

### 3.3. Snails Gathering

#### 3.3.1. Quantity of Snails Gathered per Village

The quantity of *Achatina achatina* collected all the year is estimated to 13.61 tons approximately 307.44 bags (Figure 2a). What corresponds to approximately 98 034 snails. The villages of Petit-Yapo and Grand-Yapo present the highest quantities with respectively 95.08 bags (4.21 tons; 31%) and

86.39 bags (3.82 tons; 28%). Aké-Béfiá occupies the last position with 7.65 bags (0.34 tons; 2%).

As for *Archachatina ventricosa*, the quantity taken in the forest is estimated to 1.69 tons (37 bags) (Figure 2b). What corresponds to 57 680 snails. Petit-Yapo and Grand-Yapo are the largest providers with respectively 10.96 bags (0.50 tons; 30%) and 10.86 bags (0.49 tons; 29%). The villages Aké-Béfiá and Elévi come in last positions with each one 1.22 bags (0.06 tons; 3%).

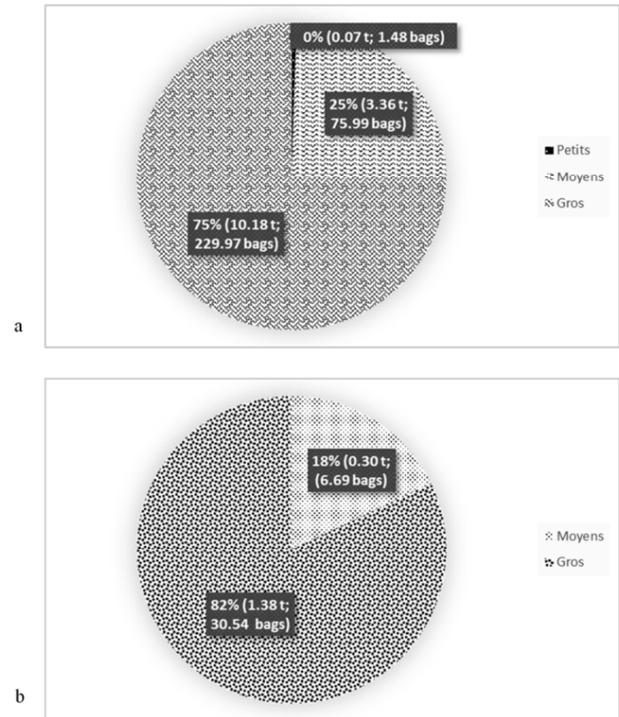
**3.3.2. Quantity of Snails Gathered per Size**

The quantity of *Achatina achatina* collected is mainly made up of individuals of big sizes with 229.97 bags (10.18 tons; 75%) (Figure 3a). Contrary to *Achatina achatina*, the snails *Archachatina ventricosa* gathered are made up individuals of big sizes 30.54 bags (1.38 tons; 82%) and individuals of mean sizes 6.69 bags (0.30 ton; 18%) (Figure 3b).

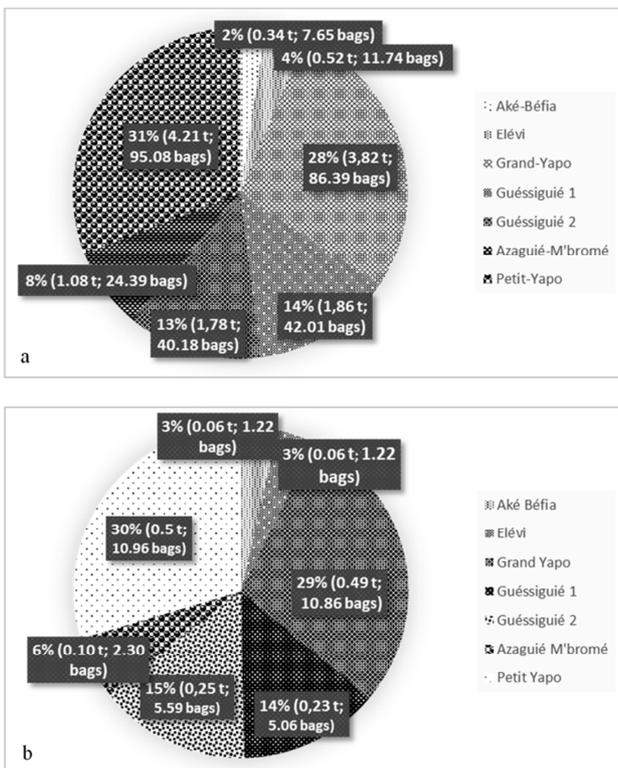
**3.3.3. Quantity of Snails Gathered per Season**

The quantities of snails collected vary according to seasons (Figure 4). The period of great rainy season corresponds to the period of great collection (5.56 tons) at *Achatina achatina*. It is followed by the small rainy season (4.34 tons) and the small dry season (3.69 tons). The gathering is almost null during the great dry season with 0.01 ton of snail.

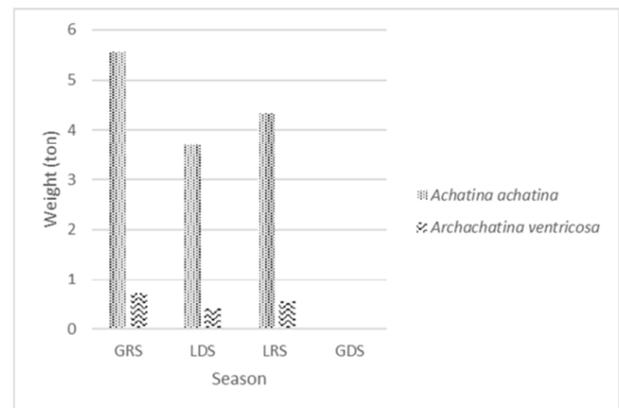
Like *Achatina achatina*, the quantity of *Archachatina ventricosa* collect was maximum during the large rainy season (0.71 ton) and minimal at the large dry season (0.02 ton). The small dry and rainy seasons recorded respectively 0.41 ton and 0.55 ton of snails collected.



**Figure 3.** Quantities of snails collected per size by the bordering populations of Yapo classified forest during the year of 2015; a: *Achatina achatina*, b: *Archachatina ventricosa*.



**Figure 2.** Quantities of snails collected by the bordering villages of Yapo classified forest during the year of 2015; a: *Achatina achatina*; b: *Archachatina ventricosa*.



NB: GRS: great rainy season; LDS: little dry season; LRS: little rainy season; GDS: great dry season

**Figure 4.** Seasonal variation of snail's quantity collected by the bordering population of Yapo classified forest during the year of 2015.

**3.3.4. Number of Snails Gathered per Day**

i. Average Number of snails Gathered per Day in each village

Table 1 shows the average catches by day of achatines by locality. The highest averages of the daily catches are recorded in the villages of Petit-Yapo ( $15.97 \pm 5.38$  snails per day) and of Grand-Yapo ( $15.32 \pm 5.43$  snails per day) for *Achatina achatina*. The low value is recorded at Aké-Béfiá ( $5.26 \pm 3.53$  snails per day). Concerning *Archachatina ventricosa*, the highest averages of the daily catches are recorded in the villages of Petit-Yapo ( $7.36 \pm 4.02$  snails per day) and Grand-Yapo ( $6.97 \pm 3.87$  snails per day). The smallest values were recorded at Aké-Béfiá ( $2.2 \pm 1.61$  snails per day).

**Table 1.** Average number of snails per day collected by the bordering villages of Yapo classified forest.

Average number of snails/day	Aké-Béfia	Elévi	Grand-Yapo	Guéssigué I	Guéssigué II	Azaguié M'bromé	Petit-Yapo
<i>Achatina achatina</i>	5.26±3.53 <sup>a</sup>	10.53±6.70 <sup>ab</sup>	15.32±5.43 <sup>b</sup>	14.08±6.20 <sup>b</sup>	14.83±5.98 <sup>b</sup>	9.61±5.41 <sup>a</sup>	15.97±5.38 <sup>b</sup>
<i>Archachatina ventricosa</i>	2.2±1.61 <sup>a</sup>	4.28±2.62 <sup>ab</sup>	6.97±3.87 <sup>b</sup>	6.05±3.53 <sup>ab</sup>	5.76±3.21 <sup>ab</sup>	2.71±0.72 <sup>a</sup>	7.36±4.02 <sup>b</sup>

NB: The values of lines affected by the same letters are not statistically different with the HSD test of Tukey to  $P < 0.05$

ii. Number of snails Gathered per Day according to the sex

The number of snails collected per day according to the sex varies between 1 from 30 (Table 2). In this activity, Number of snails Gathered per Day by the men is higher than that of the women: 1 to 20 snails per species for men against 1 to 20 for *Achatina achatina* and 1 to 3 for *Archachatina ventricosa* for women. The daily number of snails obtained by the male sex is statistically higher than that of the female sex to the  $\chi^2$  test ( $P < 0.05$ ).

iii. Number of snails Gathered per Day according to the profession

The daily number of snails collected by each profession is presented by table 2. The daily number from 1 to 3 snails are dominated by the growers (45.5%) for *Achatina achatina*. We recorded 33% of growers and 30% of medicinal plants researcher gathering 4 to 5 snails per day. For the catches from 10 to 15 snails per day, there is slight predominance of growers (35.20% of surveyed). For those from 15 to 20 snails per day the gathering is dominated by growers (45%) and medicinal plants researchers (35.90%). Housewives were absent. For *Archachatina ventricosa* species the gatherers

from 1 to 3 and from 4 to 5 snails per day are mainly made up by the growers with the respective proportions of 82.40% and 80%. The growers (50.90%) and the other professions (47.30%) make the main part of the gatherers of 10 to 15 snails per day.

iv. Number of snails Gathered per Day according to the age

Concerning *Achatina achatina* the daily catches from 1 to 3 snails are dominated by adults 2 (38.5%) and adults 3 (38.5%) (Table 2). Adults 1 (49%) are in heads for the catches from 4 to 5 snails per day followed by adults 2 (33%). For the quantities from 10 to 15 and 15 to 20 snails per days there are a respective predominance of adults 1 (36% and 65.6%) and adults 2 (65% and 34%).

The number of snails per day varies from 1 to 15 for *Archachatina ventricosa* (Table 2). Adults 1 and adults 2 constituted the major parts of the gatherers who collected from 1 to 3 snails per day (61% for adult 1 and 37.3% for adult 2) and from 10 to 15 snails per day (56.4% for adult 1 and 43.6% for adult 2). For the catches from 4 to 5 snails per day only adults 2 were majority.

**Table 2.** Number of snails collected per day according sexe, profession and age by the bordering populations of Yapo classified forest.

Species	Number of snails/day	Sex		Profession			
		Mal	Femal	Grower	Housewife	Medicinal plant researcher	Other Job
<i>Achatina achatina</i>	1 to 3	72.7% <sup>a</sup>	27.3% <sup>b</sup>	45.5% <sup>c</sup>	27.3% <sup>d</sup>	0.0% <sup>e</sup>	27.3% <sup>d</sup>
	4 to 5	79.0% <sup>a</sup>	21.0% <sup>b</sup>	33.0% <sup>c</sup>	21.0% <sup>d</sup>	30.0% <sup>c</sup>	16.0% <sup>d</sup>
	10 to 15	81.7% <sup>a</sup>	18.3% <sup>b</sup>	35.2% <sup>c</sup>	19.0% <sup>cd</sup>	20.4% <sup>d</sup>	25.4% <sup>cd</sup>
	15 to 20	100.0% <sup>a</sup>	0.0% <sup>b</sup>	45.0% <sup>c</sup>	0.0% <sup>d</sup>	35.9% <sup>c</sup>	19.1% <sup>c</sup>
<i>Archachatina ventricosa</i>	1 to 3	98.3% <sup>a</sup>	1.7% <sup>b</sup>	81.4% <sup>c</sup>	1.7% <sup>d</sup>	0.0% <sup>d</sup>	16.9% <sup>e</sup>
	4 to 5	100.0% <sup>a</sup>	0.0% <sup>b</sup>	80.0% <sup>c</sup>	0.0% <sup>d</sup>	2.5% <sup>d</sup>	17.5% <sup>e</sup>
	10 to 15	100.0% <sup>a</sup>	0.0% <sup>b</sup>	50.9% <sup>c</sup>	0.0% <sup>d</sup>	1.8% <sup>d</sup>	47.3% <sup>ce</sup>

**Table 2.** Continued.

Species	Number of snails/day	Age				
		Child (8 to 10 years)	Teenager (10 to 18 years)	Adulte 1 (18 to 30 years)	Adult 2 (30 to 40 years)	Adult 3 (40 to 50 years)
<i>Achatina achatina</i>	1 to 3	15.4% <sup>f</sup>	0.0% <sup>g</sup>	7.7% <sup>h</sup>	38.5% <sup>g</sup>	38.5% <sup>g</sup>
	4 to 5	0.0% <sup>fg</sup>	5.0% <sup>g</sup>	49.0% <sup>h</sup>	33.0% <sup>h</sup>	13.0% <sup>g</sup>
	10 to 15	0.0% <sup>f</sup>	22.1% <sup>g</sup>	36.4% <sup>g</sup>	32.9% <sup>g</sup>	8.6% <sup>e</sup>
	15 to 20	0.0% <sup>f</sup>	0.0% <sup>f</sup>	65.6% <sup>g</sup>	34.4% <sup>g</sup>	0.0% <sup>f</sup>
<i>Archachatina ventricosa</i>	1 to 3	0.0% <sup>f</sup>	1.7% <sup>f</sup>	61.0% <sup>g</sup>	37.3% <sup>g</sup>	0.0% <sup>f</sup>
	4 to 5	0.0% <sup>f</sup>	0.0% <sup>f</sup>	25.0% <sup>g</sup>	67.5% <sup>h</sup>	7.5% <sup>g</sup>
	10 to 15	0.0% <sup>f</sup>	0.0% <sup>f</sup>	56.4% <sup>g</sup>	43.6% <sup>g</sup>	0.0% <sup>f</sup>

NB: The values of lines affected by the same letters are not statistically different with the  $\chi^2$  test to  $P < 0.05$

**3.3.5. Number of Snails Gathering Days per Month**

i. Average numbers of gathering days in the month per village

Beyond Aké-Béfia ( $5.47 \pm 2.29$  day per month) and Azaguié M'bromé ( $6.66 \pm 2.64$  day per month) which had the smallest values, the other localities had values which vary from  $8.07 \pm 2.82$  and  $9.23 \pm 2.55$  days of gathering in the month. The statistical analysis showed a significant difference between the gathering days of Aké-Béfia, Azaguié M'bromé and other villages.

ii. Average numbers of gathering days in the month per sex

The average numbers of days of gathering in the month per sex is summarized in table 3. It starts from 4 to 16 days per month. The women collected 4, 8 and 10 days per month with a proportion statistically higher for the monthly collecting from 4 to 8 days than those 10 days per month. The male sex had many gathering day much more than the female sex (4 to 12 days per month). The proportion of the men at the various collecting days is statistically higher than that of the women.

iii. Average numbers of gathering days in the month per profession

Among the gatherers who collected 4 days in the month, housewives and medicinal plants researchers come in heads with each 30.50% of manpower (Table 3). For 8 days of collecting per month, the medicinal plants researchers arrive

in heads (38% of manpower) follow-up of growers (27.40% of manpower). The housewives took the last place with 13.40% of manpower. The 10 days of collecting per month is largely dominated by the growers with 77.60% of manpower. The growers and the other professions occupy the major part of the 12 days of collecting per month with the respective proportions of 52.10% and 28.10%. Housewives had absent.

iv. Average numbers of gathering days in the month per age

Adults 2 dominated the collecting of 4 days in the month (61.00%). As for the 8 days of collecting per month, adults 1 (62.40%) dominated followed by adults 2 (26.10%). The proportion of these previous age increases slightly at the collecting of 10 days with 65.3% and 28.60% respectively for adults 1 and adults 2. Only teenagers (28.10%), adults 1 (46.90%) and adults 2 (25.00%) were present in collecting of 12 days per month.

**3.4. Tendency During the Two Last Decade**

When we asked if catches decreased, all villager unanimously recognized that there is decrease. Those revealed that this decreased was due to deforestation for 25.30% of the cases, the decrease of pluviometry for 15.90% of the cases and for 15.60% of cases to the excessive collecting. Another group (19.5%) thinks that it is due to the combined effect of the three above mentioned causes.

*Table 3. Number of collecting day of snails per month according sex, profession and age by the bordering populations of Yapo classified forest.*

Number of collecting day/month	Sex		Profession			
	Mal	Femal	Grower	Housewife	Medicinal plant researcher	Other job
4	68.3% <sup>a</sup>	31.7% <sup>b</sup>	19.5% <sup>c</sup>	30.5% <sup>d</sup>	30.5% <sup>d</sup>	19.5% <sup>c</sup>
8	86.6% <sup>a</sup>	13.4% <sup>b</sup>	27.4% <sup>c</sup>	13.4% <sup>ce</sup>	38.2% <sup>d</sup>	21.0% <sup>d</sup>
10	93.9% <sup>a</sup>	6.1% <sup>b</sup>	77.6% <sup>c</sup>	6.1% <sup>d</sup>	4.1% <sup>d</sup>	12.2% <sup>d</sup>
12	100.0% <sup>a</sup>	0.0% <sup>b</sup>	52.1% <sup>c</sup>	0.0% <sup>d</sup>	19.8% <sup>c</sup>	28.1% <sup>ce</sup>

*Table 3. Continued.*

Number of collecting day/month	Age				
	Child (8 to 10 years)	Teenager (10 to 18 years)	Adult 1 (18 to 30 years)	Adult 2 (30 to 40 years)	Adult 3 (40 to 50 years)
4	2.4% <sup>f</sup>	2.4% <sup>f</sup>	14.6% <sup>e</sup>	61.0% <sup>h</sup>	19.5% <sup>e</sup>
8	0.0% <sup>f</sup>	3.8% <sup>f</sup>	62.4% <sup>e</sup>	26.1% <sup>h</sup>	7.6% <sup>f</sup>
10	0.0% <sup>f</sup>	2.0% <sup>f</sup>	65.3% <sup>e</sup>	28.6% <sup>h</sup>	4.1% <sup>f</sup>
12	0.0% <sup>f</sup>	28.1% <sup>e</sup>	46.9% <sup>e</sup>	25.0% <sup>e</sup>	0.0% <sup>f</sup>

NB: The values of lines affected by the same letters are not statistically differen with the  $\chi^2$  test to  $P < 0.05$

while 23.70% of persons surveyed do not have any idea. According to the investigation the decrease started from 1995 (9.1% of cases), 2005 (12% of the cases) and 2010 (78.90% of cases). Quantitatively the quantity of snails collected per day from 1995 to 2010 were 80 to 130 with an average of  $103 \pm 21.81$  snails per day. The quantity of achatines gathered passed from 80 to 130 snails to 1 to 15 snails by day.

**4. Discussion**

*Achatina achatina* and *Archachatina ventricosa* were the subject of gathered in Yapo classified forest of. Some studies showed that these two species are more appreciated by ivorians [8]. That justifies their collection and their sale on the markets of Abidjan [8, 6, 16].

The collection of snails was dominated by the male sex

with a proportion of 83%. Indeed, the gathering being done at night or early the morning, it is difficult for the women to take share. Those making the domestic job at early the morning before going to fields. Similar studies at Benin showed a high representativeness of the male sex in the achatines gathering [19].

Six ethnic groups take part in snails collecting. The ethnic group Abbey are most numerous (87.50%). This report could be explained not only by the predominance of this ethnic group our study area, but also by the fact that this ethnic group have snails gathering in its practice. This observation corroborate those of Nyameasem and Borketey-La (2014) who said that in West Africa, snail meat has, traditionally, been a major ingredient in the diet of people living in the high forest belts of West Africa.

The collecting of achatines is practised by all the age categories. The young people from 18 to 30 years (48.70%) and from 30 to 40 years (33.60%) be most represented. These results could be due to the fact that this activity is practised at hours which do not support the presence of the women and the children in forest. Indeed, the gatherings hours early the morning coincide with the domestic works of women and the preparations for school for the children. These results are different from those of Sodjinou *et al.* (2001). The works of these authors showed that the achatinicole gathering in Benin is mainly occupied by the children with a proportion of 37% of the gatherers.

Snail is taboo for 69.57% of no consumers for reasons which were not given. Otchoumou (1997) and Mbétid-Bessane (2006) indicated these cases of taboo in their works respectively in Côte d'Ivoire and Central Africa.

The quantity of *Achatina achatina* on all period of collection was 13.60 tons (98 034 snails) while that of *Archachatina ventricosa* was 1.69 tons (37 snails). Petit-Yapo and Grand-Yapo Villages were the largest gatherers for the two species. The great part of these two villages could be due to their geographical position. They are located of edge of road on the axis Abidjan-Agboville. The travelers stop to supply themselves as well as the resellers coming from Abidjan. This could increase the gathering. In addition the size of the population of these two villages higher than that of the other villages could act proportionally on the quantity of snails gathered. Indeed, the snail's consumption increased significant because of demography increasing and of the evolution of the food practices [11].

The gathering is mainly directed towards the individuals of large and mean sizes. That would correspond to the reproducers size. The seasonal variation of the catches showed that the rainy periods of season correspond to the periods of great collecting. The snail is an animal which affections wet environment with good pluviometry. The rain favour the relative humidity of environment which factors are favorable to the activities of these animals [3]. Our results agree with those of Memel (2009) which showed that the Achatinidae abound in rainy season period.

The sexes masculine and female gathered the same quantity of *Achatina achatina* per day (1 to 15 snail/day). But

for *Archachatina ventricosa*, the male sex collects more snails (1 to 15 snail/day) than the female sex (1 to 3 snail/day). This difference could be due to the fact that at the Abbey ethnic group *Archachatina ventricosa* is taboo for the women. Whereas the present study showed that it is the majority ethnic group among surveyed persons. That was also noticed by Mbétid-Bessane (2006) in Central Africa where the large snails *Achatina achatina* should not be consumed, according to the habit, by women and children at Benin by Sodjinou *et al.* (2002) at the pregnant women.

Among the different professions, growers and medicinal plants researchers were more active in the snails gathered. Those are accustomed to the forest. Because of their activity they acquired experiment in the techniques of gatherings. It is the same case for the ages where the adults whatever their ages had more achatine collecting per day contrary to the children and teenagers. However this case could be particular to our study since in Central Africa they are rather the children who are most active in this activity [9].

The number of *Achatina achatina* caught per day remained always higher than that of *Archachatina ventricosa* whatever the village, sex, age or the profession. *Archachatina ventricosa* would be less prolific since it expels only from 3 to 12 eggs during a laying. Whereas *Achatina achatina* can produce from 69 to 500 eggs per laying [22, 15]. Also the great taboo around *Archachatina ventricosa* can explain this observation.

The proportion of the men at the various collecting were statistically higher than that of women. The achatinicole gathering thus remains an activity with male predominance.

Generally the number of collecting days in the month was dominated by the growers and the plants medicinal researchers. Their activities being held in forest or around the forest it is easier for them to go more on the gathering place.

The number gathering day within the various ages categories showed that the young people are most active. Adults 1 were present in all the leaving. Whereas adults 3 were absent in the leaving from 2 to 10 days in month. Children remaining at 4 days of collecting. The age would be a significant factor in the collection of snails. Younger adults 1 can support the constraints related to this activity (tiredness due to the long walking in forest, skill in gathering etc). Also the family responsibility of adults 2 would be a factor which would conduct them to lean towards their principal activities.

The decrease of the collections was recognized by all persons inquired. This decrease noticed since 1995, was accentuated since 2010 passing from 80 to 130 snails to from 1 to 15 snails per day. Deforestation, the decrease of pluviometry and the excessive collecting of achatines were the reasons evoked by the majority of the collectors. Our results corroborate those of Odji (1998) and Kouassi *et al.* (2008) which showed that from 1998 to 2008, provisioning of Abidjan is passed from 17 000 to 1 700 tons. The decrease of achatines quantities was also underlined at Benin by Sodjinou *et al.* (2001). Increase of pressure upon natural populations of snails during the last years was observed in Romania and in São Tomé Island where 62% of the

households consume giant snails [4, 2]. However the reduction recorded in our work was largely higher than that of Sodjinou *et al.* (2001) which was from 51 to 35 achatines per day in 10 years. That reveals the pressure exerted on natural stock of the achatine in Côte d'Ivoire. The sociopolitic crisis that Côte d'Ivoire knew since 2002 contributed to forest degradation and the excessive gathering of snails. This suffering of a lack of adequate monitoring by the agents of water and forests.

The classified forests and the protected areas remain the only places for the conservation of snails. It is thus desirable to reinforce their monitoring in order to prevent the excessive poaching of these animals. The majorities of the collections are directed towards the animals of large sizes which would be reproducers and is done in rainy season. That corresponds to their period of reproduction. In order to preserve this resource, the populations must be sensitized. The interdiction of the gathering during the period of laying or the fixing of achatines quantity to be collected proves to be necessary. Also the State must it promote breeding of achatine at the bordering populations of protected areas in order to decrease or eradicate the pressures exerted on those. This would bring money to the populations because snail farming enterprise is profitable [1]

## 5. Conclusion

The study carried out on the gathering of edible snails revealed that the edible snail species collected in Yapo classified forest were *Achatina achatina* and *Archachatina ventricosa*. The principal actors who take an active share with the achatinicole gathering were in the great part the male sex, the growers, the medicinal plants researchers and the adults whose age varies from 18 and 40 years. The quantity of achatines gathered passed from 80 to 130 snails to from 1 to 15 snails per day in 20 years. The gathering which is carried out mainly in period of reproduction of these species is mainly directed towards the individuals of large sizes. Measures must be taken in order to perennialize this resource.

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