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Spatial distribution and occurrence of terrestrial Gastropod Molluscs in the National Center of Floristic (NCF) of Abidjan, Côte d'Ivoire

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ABSTRACT: The terrestrial Gastropod Molluscs of the National Center of Floristic (NCF) were studied in this work through their relative abundance, their frequency of occurrence as well as their density of population. To do this, quadras were delineated on the different parcels of the NCF and a stratified sampling was applied. Two sampling methods, namely the direct collection method and the litter sampling method, were used for the collection of specimens. The individuals collected were identified and counted. A total of 4,216 specimens of terrestrial Gastropod Molluscs were collected. Achatinidae and Subulinidae are numerically the most abundant with 54.06% and 42.08% respectively of the molluscs harvested. Only species of the family Achatinidae have a frequency of occurrence greater than 50% so can be considered constant. In terms of stand density, it is very high for micro-species and low for Achatinidae (large species). Achatinidae are mostly found in the arboretum while micro-species are mainly concentrated in fallow. In addition, NCF molluscs are characterized by either high abundance or regular distribution. In addition, of the three microhabitats used, the habitat who includes the soil surface, below the litter, on the litter and under the trunks of trees lying on the ground is the most inhabited by the molluscs of the NCF.

KEYWORDS: Relative abundance, occurrence, density, mollusc, terrestrial gastropods.

1 INTRODUCTION

According to Côte d'Ivoire's fifth national report on biological diversity published in 2014, terrestrial gastropod molluscs account for only 0.01% of Ivorian fauna [1]. Yet several studies indicate that Molluscs are the most diverse phylum after Arthropods [2] and [3]. In addition, in many parts of the world, terrestrial Gastropod Molluscs occupy a large part of the fauna of forest ecosystems [5], [6], [7] and [8]. This minute proportion of terrestrial gastropod molluscs in Côte d'Ivoire certainly does not mean that this group is not rich in species; it would rather reflect the few studies that have been devoted to them. In fact, recent work in Côte d'Ivoire reveals a high diversity and high abundance of these molluscs [9], [10] and [11]. The choice of the National Center Floristic (NCF) as study area is strategic because although this center is full of important fauna, the animals of the center are not previously taken into account in the management of the center. The objective of this study is to show the numerical importance of these molluscs in Ivorian forest ecosystems, in particular that of the NCF, in order to strengthen their consideration in the management of Ivorian forest ecosystems.

2 METHODS

2.1 STUDY AREA

The CNF is located in the University Felix Houphouet Boigny of Abidjan (in southern Côte d'Ivoire). The center is located between 05 ° 34'74.09 N latitude and -3 ° 98'38.61 W longitude. The garden is delimited by a perimeter layon lined with a fence. It is traversed internal and peripheral alleys delimiting several thematic plots **(Figure 1**).

The climate of the NCF is that of Abidjan which Guinean type is. Indeed, it is characterized by four seasons differentiated by their rainfall regime: the great rainy season which starts from March to July with a maximum of precipitation in June and the small rainy season which covers the months of September, October, November and December with a high of precipitation in October. These two wet seasons are separated by a short dry season that covers only the month of August and a long dry season that runs from January to February. The temperatures of the city of Abidjan are relatively mild. They vary from 24.54 ± 0.3 ° C for the month of August considered the coldest month to 28.11 ± 0.52 ° C for the month of April considered as the hottest month. The maximum value of the recorded temperature is 35.5 ° C.

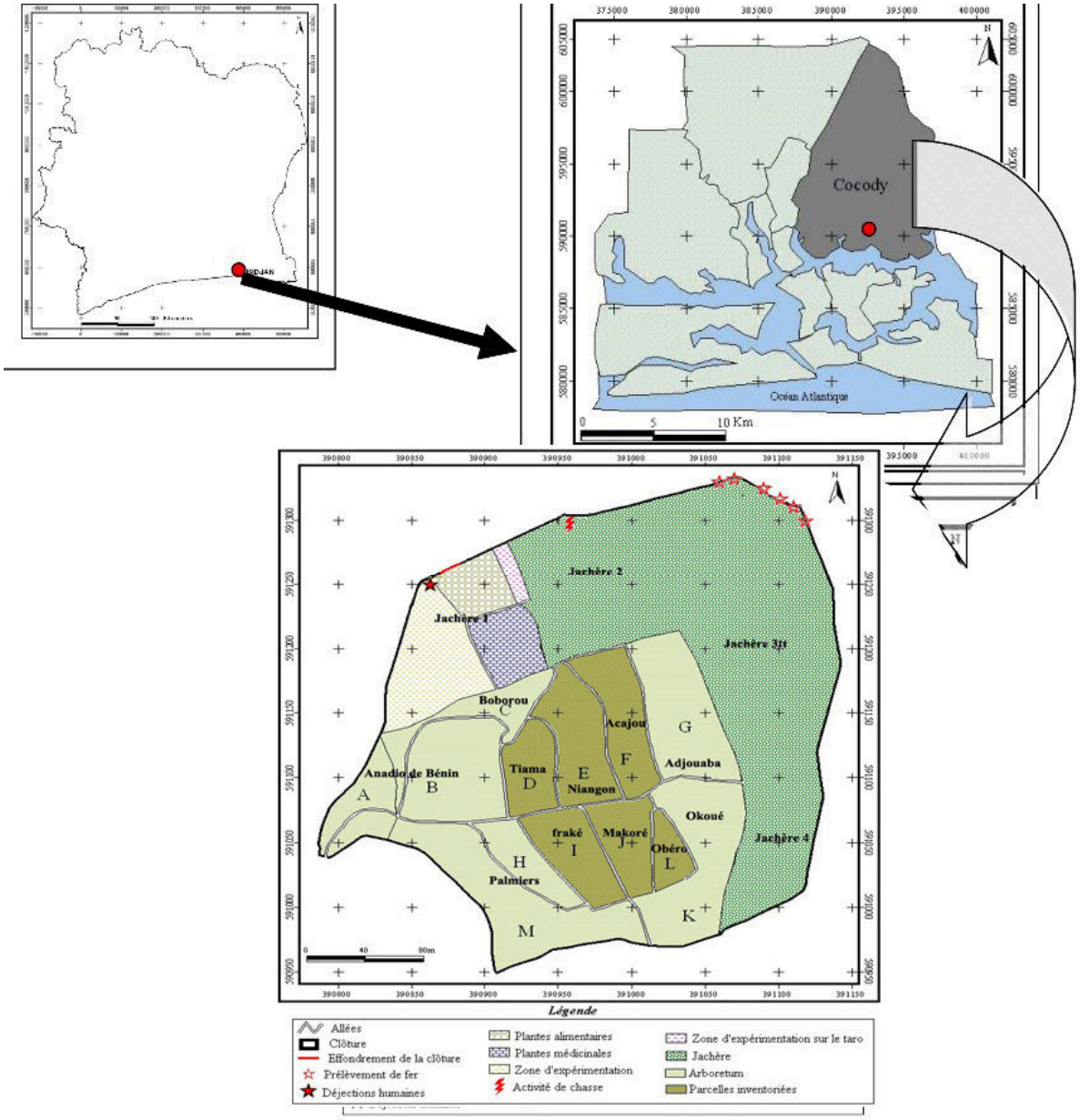

Fig. 1. Location of the National Center of Floristic within the Félix Houphouët-Boigny University

As for precipitation, they give an average of 126.9 ± 55.76 mm of rain per month. The wettest month is June with an average of 415.1 ± 22.8 mm. The month of January remains generally the driest with an average of 16.8 ± 4.49 mm. The relative humidity of the ambient air remains high throughout the year because of the distribution of rainfall over the months. It ranges from 82 ± 0.84% (January) to 91.7 ± 2.19% (August) with an average of 87.2 ± 2.75%.
(http: // www.tutiempo.net/en/climate/Abidjan/655780.htm)

The NCF's vegetation is dominated by dense moist evergreen forest. It is characterized by the presence of two species: *Turraeanthus africanus* (Meliaceae) and *Heisteria parvifoliaSm* of the family Olacaceae. The NCF is also populated with savanna species and species from other ecological zones that are more discreet. The arboretum of the botanical garden houses a large collection of plants estimated at 750 species belonging to the Ivorian flora, as well as that of the subregion. In addition, the NCF has an herbarium that contains about 19,500 samples of Ivorian and West African flora species.

2.2 METHOD

Sampling took place from January 2017 to December 2018 within a period of 24 months. It took into account all the terrestrial Gasteropod Mollusc species indentified in the NCF by [9]. To do so, stratified sampling was retained. It is appropriate when the area of interest is not homogeneous ; this is often the case in nature because most other methods have the disadvantage of neglecting small areas, but they are original [12]. This type of sampling is appropriate for the NCF because it is a very heterogeneous forest. This method consists of a prior division, at one or more levels, of the studied area, based on elements such as the structure of the landscape, the structure of the vegetation, its nature, etc. It also allows in many cases to reduce the sampling error [13]. This method provides both lists of species (qualitative sampling) and quantitative data on the abundance of these species, expressed in terms of indices or densities (quantitative sampling) [12]. The NCF forest has two main parts: an arboretum with an area of 4.25 hectares divided into 11 plots by artificial boundaries and numbered from 1 to 11 (**figure 1**). Each of these parcels is assigned a name. As for the part not yet exploited, it is a secondary forest still known as a fallow area of 6 hectares. For sampling reasons, we divided this forest by imaginary limits into four parts denoted JACHERE1 (J1), JACHERE2 (J2), JACHERE3 (J3), and JACHERE4 (J4). In each plot, two quadras whose total area is equal to 5% of the area of the parcel on which they are located have been delineated monthly. This delineation of the quadras was done randomly taking into account the canopy physiognomy (type of canopy and litter thickness). Each month, two new quadras are delineated at other locations in each of the parcels. Thus, each month, 30 quadras have been delimited and sampled. This rotation of the quadras samples not only the entire surface of the NCF, but also the different strata that compose it. This also allowed to collect a maximum of Mollusc. Two survey methods were used for molluscan collection: the so-called direct or sighted survey method for large species and the soil and litter sampling method for micro-species [14]. In addition, [15] recommend a similar approach by combining timing, direct visual search, soil harvesting, and litter for a quantitative study of Molluscs in forests. The direct method consists of an intensive search of each plot by four active researchers during one hour, between 5 and 8 am. All the places likely to shelter snails, in particular the wet places, were prospected. Thus, snails on the ground, on or under the leaves of shrubs, on the branches and on the trunks of living or dead trees, were collected. During each outing, 5 dm^3 of soil were collected in each plot as most of the microspecies live in this soil thickness. This soil was dried in a dry and cool place at 18°C for four days and was then sieved on a sieve column with decreasing mesh size (10 mm to 3 mm). Each sieve refusal was searched and the part of the soil that passed through the 3 mm mesh was searched with a magnifying glass. This method is called indirect. Identification of the specimens was done using morphological criteria and with the use of standard identification keys [6], [15] and [16].

2.3 DATA ANALYSIS

- **Relative dominance or relative abundance**

It is the number of individuals of a given species divided by the total number of individuals of all species combined. This index is denoted DA (Z) or DA% (Z) depending on whether it is expressed in terms of frequency or percentage. It is calculated according to the formula: $\mathrm{DA(z)} = \frac{n\mathrm{A(Z)}}{\sum n\mathrm{(Z)}}$

*n*A(Z) : number of individuals of species A in zone Z

∑*n*(Z) : number of individuals all species combined in zone Z.

- **Density**

The density (D) makes it possible to know the number of individuals present per unit area or volume [17]. It is expressed by the following formula:

$$\mathbf{D=}\frac{\text{Total of individual of the the same specie on a area}}{\text{Area (m²)}}$$

- **Frequency of occurrence**

The frequency of occurrence of a species is the ratio expressed as a percentage of the number of specimens where this species is recorded compared to the total number of samples taken:

$$\mathbf{F_A\ (Z) = \frac{P_A}{P}\ X\ 100}$$

F_A is the frequency of occurrence of species A in zone Z.

P_A is the total number of specimens from zone Z containing species A

P is the total number of samples taken.

In terms of consistency, Dajoz distinguishes three (3) groups [17]. Species in the first group are considered constant when they are found in 50% or more of the samples in the same community. Those in the second group are accessory because they are only present in 25 to 49% of the samples. Finally, accidental species have a frequency of occurrence of less than 25%.

In addition, a principal component analysis (PCA) was applied to characterize the distribution of the different species in the NCF. In addition, the Kruskal-Wallis test (a non-parametric alternative to the one-way ANOVA 1 analysis) was used to test the difference in density between different species of molluscs harvested. These data were processed by the STATISTICA version 7.0 software

3 RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1 DISTRIBUTION IN THE HABITATS

- ***Relative abundance, occurrence and densty***

The diagram in Figure 2 shows the spatial distribution of molluscs harvested in the NCF. The analysis of this diagram indicates that the arboretum, with its 4.25 hectares only, concentrates most of the molluscs. Indeed, a total of 2851 specimens corresponding to 68% of all molluscs were collected in this section. Concerning the fallow, 1,365 specimens were harvested, representing approximately 38% of all molluscs harvested. An analysis of the relative abundance of different families of molluscs indicates that the family of Achatinidae with 2,279 individuals or 54.06% of all individuals harvested is the most abundant. The Subulinidae family followed with 1,774 individuals, or 42.08% of all individual harvested mollusc, the Streptaxidae family with 128 individuals or 3.04% of all individual harvested, the Succinidae family with 18 individuals, or 0.43% of all individuals harvested. The families of Enidae and Ferussaciidae come in last position with respectively ten individuals or 0.24% and seven individuals or 0.17% of all individuals harvested. From the point of view of the number of individuals per species, *Archachatina ventricosa* is the most abundant species with 899 specimens or 21.32% of all the specimens. Following by *Limicolaria flammea* and *Achatina fulica* with 750 specimens (17.79% of all the specimens) and 630 specimens (14.94% of all the specimens) respectively, Curvella subvirescens with 402 specimens or 9.54% of all the specimens harvested. The species *Curvella sp 2*, *Curvella sp4, Subulona pattalus, Pseudopea sp2, Ennea elegantula, Gullela io, Gullela sp 1, Gonaxis sp 1, Gullela sp 2, Rachinida tumefacta, Ceciliodes sp, Quickia concisa* have the lowest proportions (< 1 %). In addition, Achatinidae (*Archachatina ventricosa, Achatina fulica* and *Limicolaria flammea*) are present, each more than 90% in the arboretum. Some species, especially *Curvella subvirescens, Curvella sp3, Subulona sp1, Subulona martensi, Subulona pattalus, Striosubulina striatella, Opeas sp1* and *Quickia concisa* have more or less balanced proportions, that is to say between 40% and 60% in the arboretum or fallow. The species *Curvella sp5, Pseudopea sp 1, Pseudopea sp2, Ennea elegantula, Gullela io* and *Gullela sp 1* are much more present in the fallow than in the arboretum. Their proportion in the fallow is greater than 60% fallow, so less than 40% in the arboretum. As for the species *Curvella sp 2, Curvella sp 4, Gonaxis sp 1, Gullela sp 2* and *Rachinida Tumefacta*, they are exclusively in the fallow. Their proportions in this area are therefore 100% (**figure 3**).

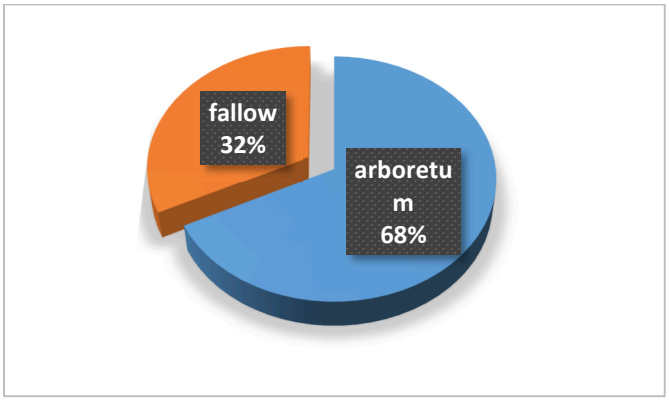

Fig. 2. Spatial distribution of Molluscs in the National Center of Floristique

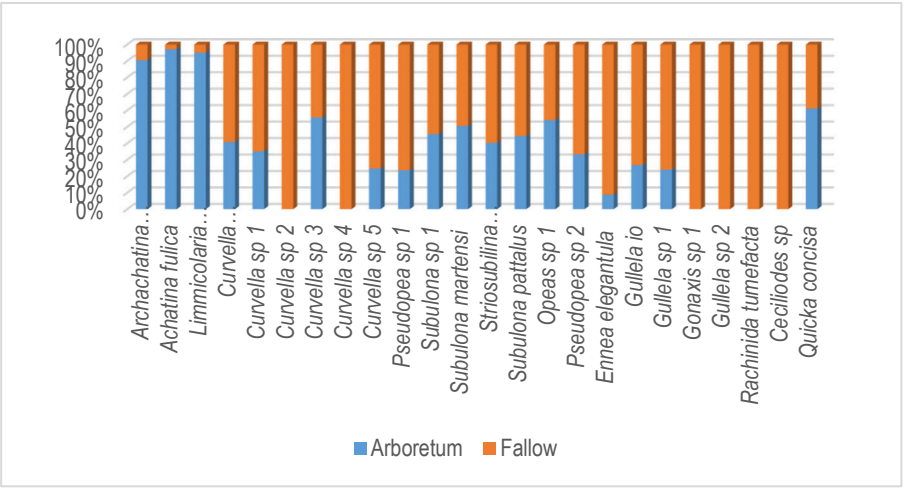

Fig. 3. Spatial distribution of the different species of Molluscs in the National center of floristic

Table I presents the frequency of occurrence of the different species harvested in the NCF. It appears that only Achatinidae can be qualified as constant species because their frequency of occurrence is greater than 50%. The species *Curvella subvescens*, *Curvella sp1, Curvella sp3, Pseudopea sp1* and *Striosubulona striatella* are accessory species because their average frequency of occurrence is between 25% and 50%. The other species can be qualified as rare species because they have frequencies lower than 25%.

Calculation of the densities of the different species indicates that the highest densities were observed in the micro species. Their average density varies between 0.11 individuals / m² (*Cecilioides sp*) to 6.48 individuals / m² (*Curvella subvirescens*). As for the macros species (Achatinidae), they have the lowest densities. Their density varies from $0.91x10^{-2} \pm 0.64 x10^{-2}$ individuals / m² (*Achatina fulica*) to 1.33x10-2 ± 0.84x10-2 individuals / m² (*Archachatina ventricosa*). In practice, the density of Achatinidae varies from 91.16 ± 59.28 individuals / ha to 133.05 ± 76.82 individuals / ha in the NCF. In addition, the Kruskal-Wallis test indicates a very highly significant difference ($p < 0.01$) between the average densities of the different species (**table II**).

- ***Species distribution according to plots***

The principal component analysis applied to individuals (species) and variables (plots) allowed them to be represented in a plane reference with two axes (x; y) also called main components or factors (**Figure 4 A&B**). The x-axis or factor 1 contains the most information (71.05%) to characterize the different species and plots. The analysis of the disposition of these species on this axis makes it possible to know that it ranks the species in descending order of their numerical abundance. This axis is therefore negatively correlated by numerical abundance. Thus *Archachatina ventricosa* (numerically the most abundant species) is diametrically opposed to *Ceciliodes sp* (numerically the least abundant species). In addition, the disposition of plots on axis 1 confirms that this axis is negatively correlated by the specific abundance of Achatinidae plots. Thus the richest parcels

in Achatinidae show a good correlation with this axis. As for the y-axis or factor 2, it summarizes about 20% of the information used to characterize species and plots. The analysis of the disposition of the species along this axis makes it possible to know that it ranks the species in descending order of their equitability in the distribution in the NCF. This axis is therefore negatively correlated by the species distribution. Thus, *Achatina fulica* (most unequally distributed) is opposed to the species *Curvella subvirescens* (species equitably the best distributed). Species close to the reference center are the species with the most abundance and distribution. Thus, the species of molluscs harvested in the NCF are characterized by their abundance and distribution.

3.1.2 DISTRIBUTION IN THE MICROS HABITATS

In the NCF, three micro habitats are used by molluscs. Those are :

- micro habitat H1: These are molluscs harvested from soil samples. It contains almost all species except *Archachatina ventricosa, Achatina fulica, Limicolaria flammea, Subulona pattalus, Gonaxis sp* 1 and *Rachinida tumefacta*. It should be noted that all individuals harvested in this habitat were all dead. Their identification was based on the shell.
- micro habitat H2 : This habitat includes the soil surface, below the litter, on the litter and under the trunks of trees lying on the ground. All species inhabit this habitat.
- micro habitat H3 : This habitat includes tree trunks and branches in height, the surface of tree trunks lying on the ground, shrub leaves and roots at height. Only Achatinidae meet in this habitat.

The study of the settlement of molluscs in these different habitats shows that the H2 microhabitat is the most popular with molluscs because there are altogether 3299 individuals, ie about 78% of all the molluscs harvested. Microhabitat H1 comes in second place with 657 individuals or 16% of molluscs and finally microhabitat H3 with 260 individuals or 6% of harvested molluscs. The distribution of different families of molluscs in different habitats (H, H2 and H3) is the following:

- The Achatinidae inhabit two habitats, namely the H2 micro habitat and the H3 micro habitat, but they do not occur in the H1 micro habitat. They occupy mostly (nearly 90%) the H2 micro habitat.
- Subulinidae, Streptaxidae, Ferussaciidae and Succinidae occur in micros habitats H1 and H2, but not in micro habitat H3. The percentage of population in each family is high in the H2 micro habitat compared to that of the H1 micro habitat. Subulinidae occur at 64.77% in the H2 micro habitat and 35.23% in the H1 micro habitat. Streptaxidae occur at 81.25% in the micro H2 habitat and at 19.75% in the H1 micro habitat. Ferussaciidae occur 71.43% in the H2 micro habitat and 28.57% in the H1 micro habitat. As for the Succinidae, they meet at 66, 67% in the H2 micro habitat and 33.33% in the H1 micro habitat.

Table 1. Frequency of occurrence of different species of Mollusc harvested in the National Center of Floristic

Species	Frequency of occurrence (%)
Archachatina ventricosa	62.78 ± 16.93
Achatina fulica	50.28 ± 24.19
Limicolaria flammea	53.33 ± 21.44
Curvella subvirescens	42.78 ± 13.15
Curvella sp 1	33.61 ± 18.15
Curvella sp 2	3.89 ± 6.22
Curvella sp 3	25.00 ± 13.33
Curvella sp 4	5.83 ± 9.33
Curvella sp 5	15.83 ± 16.22
Pseudopea sp 1	33.06 ± 23.00
Subulona sp 1	18.06 ± 9.26
Subulona martensi	16.39 ± 7.56
Striosubilina striatella	30.56 ± 10.37
Subulona pattalus	3.06 ± 3.67
Opeas sp 1	16.67 ± 10.00
Pseudopea sp 2	2.22 ± 3.26

Ennea elegantula	7.78 ± 10.37
Gullela io	8.06 ± 6.96
Gullela sp 1	4.17 ± 4.44
Gonaxis sp 1	3.33 ± 4.89
Gullela sp 2	3.06 ± 4.48
Rachinida tumefacta	2.50 ± 4.00
Ceciliodes sp	2.22 ± 3.56
Quickia concisa	3.89 ± 4.15

Table 2. Average density of mollusc harvested at the National Center of Floristic

species	Density (individual / m^2)	Standard deviation	Density (individual / ha)	Standard deviaton
Archachatina ventricosa	$1.33x10^{-2}$	$0.84x10^{-2}$	133.05	76.82
Achatina fulica	$0.91x10^{-2}$	$0.64\ x10^{-2}$	91.16	59.28
Limicolaria flammea	$1.07x10^{-2}$	$0.68\ x10^{-2}$	106.68	62.43
Curvella subvirescens	6.48	5.01	64849.70	31536.84
Curvella sp 1	4.76	4.17	47644.73	26293.73
Curvella sp 2	0.14	0.23	1378.68	1430.58
Curvella sp 3	2.33	1.42	23299.51	8960.50
Curvella sp 4	0.28	0.45	2757.35	2861.16
Curvella sp 5	1.11	1.15	11107.90	7220.18
Pseudopea sp 1	4.57	4.79	45679.89	30183.01
Subulona sp 1	2.23	1.69	22276.58	10660.00
Subulona martensi	1.43	0.82	14274.18	5140.18
Striosubilina striatella	3.63	2.49	36310.21	15689.08
Subulona pattalus	0.15	0.17	1515.40	1063.22
Opeas sp 1	1.41	0.83	14104.53	5228.19
Pseudopea sp 2	0.15	0.19	1488.82	1185.39
Ennea elegantula	0.53	0.70	5318.48	4414.85
Gullela io	0.66	0.67	6600.94	4206.07
Gullela sp 1	0.40	0.47	4034.75	2944.11
Gonaxis sp 1	0.18	0.28	1838.24	1771.19
Gullela sp 2	0.25	0.40	2450.98	2543.25
Rachinida tumefacta	0.15	0.25	1531.86	1589.53
Ceciliodes sp	0.11	0.18	1072.30	1112.67
Quickia concisa	0.31	0.31	3077.65	1947.69

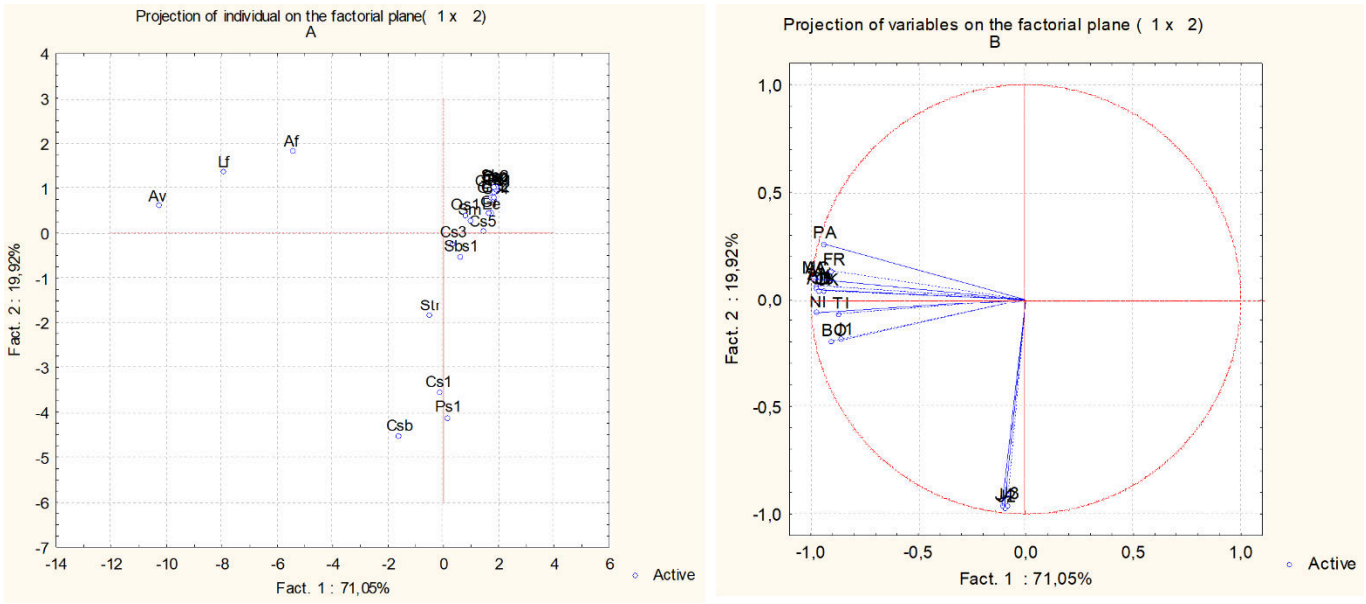

Fig. 4. Characterization of distribution of species according to plots

AN : Anadio de Bénin ; BO : Boborou ; TI : tiama ; NI : Niangon ; AC : Acajou ; AD : Adjouaba ; OK : Okoué ; OB : Obéro ; MA : Makoré ; FR : Fraké ; PA : Palmiers ; J1 : Jachère 1 ; J2 : Jachère 2 ; J3 : Jachère 3 ; J4 : Jachère 4.

Av : Archachatina ventricosa ; Af : Achatina fulica ; Lf : Limicolaria flammea ;Csb : Curvella subvirescens ; Cs3 : Curvella sp3 ; Sb1 : Subulona sp1 ; Sm : Subulona martensi ; Sbp : Subulona pattalus ; Str : Striosubulina striatella ; Os1 : Opeas sp1 ; Qc : Quickia concisa ; Cs5 : Curvella sp5 ; Ps1 : Pseudopea sp 1 ; Ps2 : Pseudopea sp2 ; Ee :Ennea elegantula ; Gi : Gullela io ; Gs1 : Gullela sp 1 ; Cs2 : Curvella sp 2 ; Cs4 : Curvella sp 4 ; Go : Gonaxis sp 1 ; Gs2 : Gullela sp 2 ; Rs : Rachinida Tumefacta,

3.2 DISCUSSION

The Achatinidae family with its three species is the most dominant of all the Mollusc families harvested. This dominance could be explained firstly by the fact that unlike other families, Achatinidae, especially those harvested in the NCF, are less sensitive to variations in climatic conditions and disturbances due to anthropogenic actions. Indeed, these Achatinidae, because of their area of distribution (generally in Africa according to [18]), are more or less accustomed to temperature variations. These results are in the same direction as those reported by [19]. This author has reported that *Achatina fulica* and *Archachatina ventricosa* support low humidities but also strong humidities. Moreover, they are used to human presence [20]. In addition, this abundance of these Achatinidae may be related to their reproductive performance. Indeed, *Achatina fulica* is a very prolific species that has an early sexual maturity (7 to 8 months of age). This species is able to lay up to an average of 225 eggs per egg with an hatching rate of about 65% [21], [22] and [23]. *Limicolaria flammea* can lay up to six times a year with an average of 31 eggs per egg and an hatching rate of 70% [20]. The species *Archachatina ventricosa* can lay up to nine times a year with a number of eggs ranging from three to nine per egg, an hatching rate of 70.2% and a spat mortality rate of 20% [24]. Moreover, *Achatina fulica* and *Limicolaria flammea* are not part of the molluscs consumed in large quantities by the Ivorian populations [22] and [23]. In addition, the construction of the fence around the NCF could help explain this abundance. Indeed, thanks to this fence, access to the center is controlled so that it now possible to prevent and curb the collections of these Achatinidae. Indeed, the collection of snails is a real plague that significantly reduces the natural stock. This observation was made by [25] in the Yapo classified forest in Côte d'Ivoire.

Considering habitat (arboretum or fallow), the dominance of molluscs in general and of Achatinidae in particular is more marked in the arboretum (open habitat) than in the fallow (closed habitat). This domination is explained by the fact that the arboretum, better than fallow land, meets almost all the conditions of survival and proliferation of these molluscs. This observation is immediately contradictory with that made by [9] and by [19]. These authors noted that molluscs in general and in particular Achatinidae are more abundant in closed habitats. This observation in their work explains that most plants consumed by these molluscs meet in closed habitats. This is not the case in the NCF. Indeed, in the NCF, most of the nutritive plants of Achatinidae are in the arboretum. The distribution of Achatinidae does not appear to be primarily related to habitat type, but rather to the availability of nutrient resources. On this point, our observations are in agreement with those of [9] and

by [19]. On the other hand, photoperiod can explain this abundance of Achatinidae in the arboretum. Indeed, the arboretum being a secondary forest, it is sufficiently enlightened by the solar light. This long photoperiod is very beneficial for these Achatinidae. These results are in line with those of [23]. This author states that light has a positive influence on the growth and reproduction of Achatinidae such as those found in the NCF. However, some species of molluscs are only found in fallow or are found in the fallow majority. This could be explained by the fact that this fallow constitutes the natural forest area of the NCF. It is therefore more or less preserved from most of the NCF's human activities. This is the area of choice for micro species. For this reason, it is characterized by the presence of certain species. In addition, most of the micro-species harvested in the arboretum were already dead. This high mortality would reflect the level of disturbance of this part of the CNF. Micro-species would be more vulnerable to changes in the environment.

In addition, 18 taxa out of the total of 24, or 75% of taxa from four families (Achatinidae, Subulinidae, Streptaxidae and Enidae) are common to fallow and arboretum. This confirms the conclusions of the work of [4] and [26]. According to these authors, these taxa are more prevalent in sub-Saharan Africa

In addition, the comparison of the abundance of molluscs in the NCF with that of the Banco forest as part of the work of [19] shows a high density per hectare in the NCF forest. This observation marks a contrastwith the theory of insular biogeography [27] which states that in a fragmented environment, species richness is a function of habitat fragment size and degree of isolation. As a result, samples from Banco National Park (BNP) are expected to be richer in mollusc species. The great abundance of NCF Molluscs seems to express that the NCF is a real niche for protecting and conserving the biodiversity of molluscs. Three micro habitats are used by the NCF Molluscs. They are: H1 in the soil, H2: on the soil and in the litter and H3: on the trunks, branches and leaves. These same micro-habitats are used by the Molluscs of the Yapo Classified Forest [9]. However, the occupation of these micro habitats is variable. Micro habitat H2 is the most used by molluscs. These results are similar to those reported by [28] and by [13]. These authors reported that most of the terrestrial malacofauna would live in this micro habitat. Several reasons may explain this preference of the H2 micro-habitat. First, the presence of litter which, when it is abundant, provides adequate living conditions for microorganisms in general and for molluscs in particular. It is not only a niche nurturing for these organisms but also a shelter during times when conditions become hostile and also shelter from predators. This result corroborates that of [29]. These authors reported that litter is essential for the survival of many terrestrial molluscs. In addition, contact between molluscs and the soil is essential. Because these would extract most of the mineral elements (iron, calcium, magnesium, etc.) in the soil.

4 CONCLUSION

The national center of floristic is home to an important fauna of terrestrial gastropod molluscs. Among these molluscs, Achatinidae are the most abundant and are mostly found in the arboretum while small species (micro species) are mostly found in fallow. In addition, three micro habitats are also used as biotope by these molluscs. These micro habitats are H1 (in the soil), H2 (the soil surface, below the litter, on the litter and under the trunks of trees lying on the ground) and H3 (tree trunks and branches in height, the surface of tree trunks lying on the ground, shrub leaves and roots at height).

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