

Diversity of Edible Terrestrial Snails (*Stylommatophora*, *Achatinidae*) Recorded along the Ituri and Ubundu Road Axes (Kisangani, Tshopo, DR Congo)

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ABSTRACT

The study inventories edible terrestrial snails in Tshopo Province along the Ituri and Ubundu road axes. It compares species diversity and relative abundance according to collection periods. Along the Kisangani–Ituri road axis, investigations were conducted in the villages of Baliambobi, Bakanamuke, Basenge, Basugo, and Basukwambula, while along the Kisangani–Ubundu road axis the villages of Babolemba, Babutu, Kanana, Lusa, Mbokamalili, Obilo, and Yoko were explored. Identification of the 357 snails purchased from collectors after an interview was based on morphometric characteristics and comparison with data from the Japan Bishogai database. This led to the identification of two genera (*Achatina* and *Archachatina*) and nine operational specific taxonomic units (OSTU). Morphometric data show that OSTUs of the genus *Achatina* share similar traits, with an average of seven whorls, except for *Achatina* cf. *stuhmanni* sp2 and *Archachatina* cf. *marginata*, which exhibit variations. *Achatina* sp1a and *Achatina* sp2 are abundant along both road axes, whereas *Achatina* sp5 is poorly represented. According to collectors, snails are present throughout the year, with harvesting peaks in April along the Ituri axis and in March along the Ubundu axis during the rainy season. Snails become scarce from June to September and from December to February, when rainfall is low.

Keywords: edible terrestrial snails, diversity, abundance, periodicity, Ituri, Ubundu

INTRODUCTION

Global biodiversity is currently facing an unprecedented environmental crisis, particularly in tropical forests, which are highly diversified ecosystems (Hette, 2018) where forest management is poorly monitored. Rapid environmental degradation accelerates climate change, thereby threatening some species with extinction even before they are documented (Katuala, 2009). This degradation is caused by shifting slash-and-burn agriculture, irrational exploitation of forest resources, artisanal gold mining, and population growth (Mate, 2001; Gambalemoke, 2008; Katuala, 2009). As a result, wild snail populations have declined considerably due to pesticide use (Cobbina et al., 2008), deforestation, and the harvesting of immature individuals (Lifoli, 2021).

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The Democratic Republic of the Congo (DRC) possesses vast forest resources and hosts non-timber forest products (NTFPs) of great socioeconomic importance for both rural and urban populations (Gevaert, 2007). In Tshopo Province, indigenous peoples such as the Lokele, Bamanga, Topoke, Turumbu, and Kumu depend on hunting and the collection of invertebrates. Consequently, they exert continuous pressure on wildlife resources (Bola, 1986). In response to this situation, several studies have been conducted on the diversity of edible terrestrial gastropods in the DRC. The Institut Facultaire des Sciences Agronomiques de Yangambi (IFA) and the University of Kisangani have highlighted gaps in knowledge concerning this zoological group, thereby emphasizing the need for further studies. These works underline not only the ecological role but also the socioeconomic value chain of edible terrestrial snails for local communities. Edible terrestrial snails are abundant in Kisangani markets during the rainy season, particularly from March to May and from September to November (Juakaly, 2007; Lifoli, 2021).

Molecular sequencing of some consumed terrestrial snails (Fuka, 2017) has strengthened the interest in further studies on this zoological group in the Kisangani region, demonstrating that they had been poorly identified until now. The main research question of this study is to determine the species diversity, relative abundance, and collection periodicity of edible terrestrial snails in the forests along the Kisangani–Ubundu and Kisangani–Ituri road axes. The central objective of the study is to compare the species checklist of snails along the two road axes. The socio-scientific relevance of this research lies in generating a database on the diversity of edible terrestrial snails along both road axes and encouraging local communities to engage in the sustainable management of this food resource, thereby contributing to biodiversity conservation.

METHODS

Data collection for the present study was carried out along the Kisangani–Ubundu road in the localities of Yoko (PK 32), Batiamanango (PK 51), Mbokamalili (PK 63), Babolemba (PK 73), Obilo (PK 82), and Lusa (PK 98). Along the Kisangani–Ituri road, data were collected in the localities of Baliabombi (PK 29), Banakanuke (PK 43), Basukwambula (PK 95), Basenge (PK 113), and Basugo (PK 138). Figure 1 shows the geographical location of these different localities, which constitute the main snail collection sites.

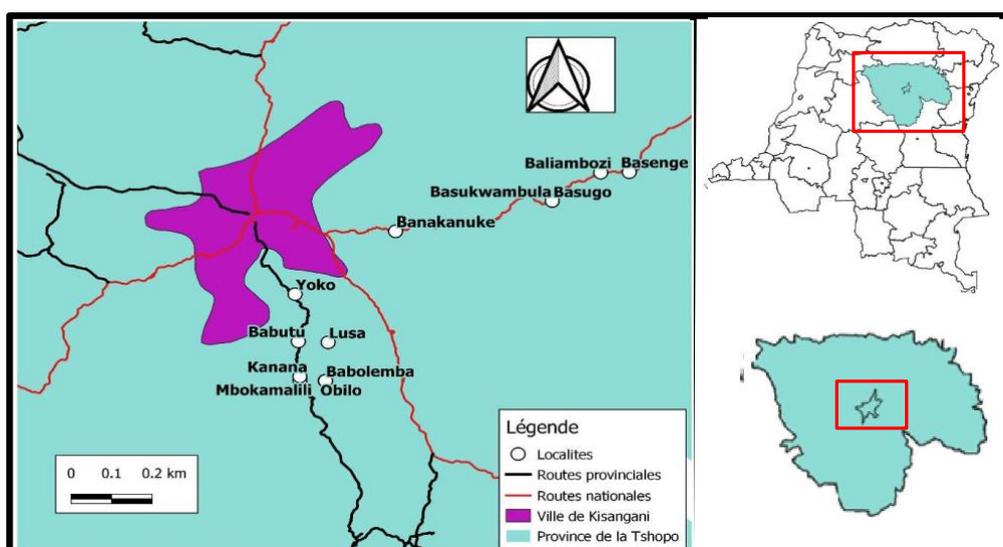


Fig. 1. Localities where edible snails were collected along the Kisangani–Ubundu and Kisangani–Ituri road axes

A preliminary survey made it possible to identify the localities where snails are generally collected along both road axes. Subsequently, field deployment was carried out during the critical harvesting period to purchase snails and to interview collectors (suppliers), retailers, and consumers. The interviews made it possible to gather essential information on each actor in the edible terrestrial snail value chain. Collectors act as primary sellers, while retailers serve as secondary sellers. Consumers include both village-level local consumers and those from urban centers.

In the laboratory, several tasks were carried out. For each locality, a batch of ten snails with intact shells was sorted to constitute a sample for tissue collection intended for subsequent molecular analyses. These tissues were preserved in Eppendorf tubes containing 96% alcohol. To group carcasses into operational specific taxonomic units (OSTUs), we examined fresh shells in detail, noting coloration, the number and direction of striations, and taking standard shell measurements. We also compared our samples with those in the Japanese Bishogai database, which holds a well-documented collection of snails from the DRC and Central Africa. For each specimen, total biomass (shell, mucus, and visceral mass) was measured using a Pesola spring scale.

After cooking the snails, the shells were emptied of their contents, cleaned with mild soap, and dried in the shade. Once dried, standard shell measurements were taken using a digital caliper with a precision of 0.01 mm. These measurements included total length (h), total width (w), aperture width (aw), aperture height (al), and the height of the spires (last 3 whorls / body whorl length).

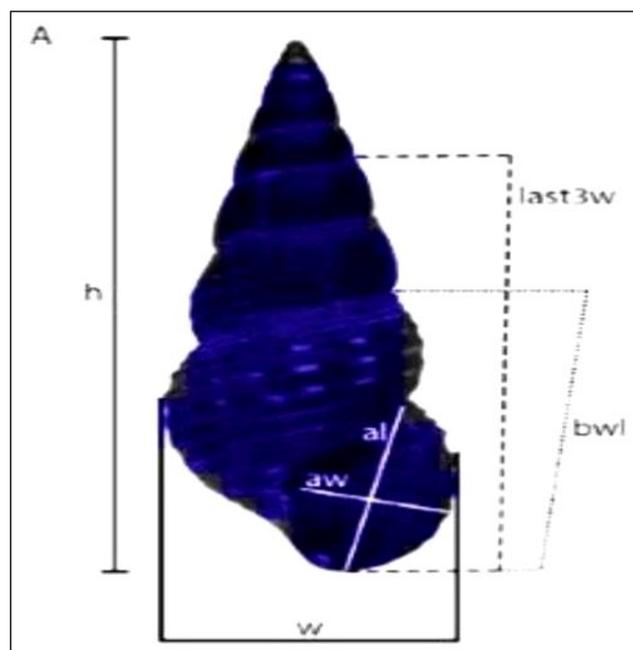


Fig. 2. Standard measurements taken on the shell of an adult specimen

Legend: h = shell height; w = shell width; al = aperture length; aw = aperture width; bwl = body whorl height; last3w = height of the last three whorls (Source: Kristin, 2011).

To group the snails into UTSO, we used the shells of the sequenced snails as a reference (Fuka, 2017). These shells were classified into three UTSOs (*Achatina* sp1–3). Shells whose characteristics did not match those described by Fuka (2017) were classified as other UTSOs. All shells were labeled and stored separately in biodegradable plastic bags according to their villages of origin in the collection room of the Biodiversity Monitoring Center of the University of Kisangani.

Ecological Indices and Statistical Data Processing

The fact that the snails were randomly collected by farmers in the forest allows a certain analogy with a random sampling design, thus making it possible to calculate ecological indices (Shannon–Wiener alpha diversity, Simpson diversity, total species richness, and evenness) to characterize the sampling.

The Shannon–Wiener index ($H\alpha'$) measures the probability that two individuals randomly selected belong to different species. It is therefore used to assess the species diversity of snails in each locality according to the formula below:

$$H\alpha' = - \sum (p_i \cdot \log p_i)$$

p_i = proportion of individuals belonging to species i relative to the total number of individuals sampled. It expresses the probability that such a specimen is encountered in a given locality and collected.

log = logarithm to base 2.

Simpson's diversity index D (formula below) ranges from 0 (no diversity) to 1 (maximum diversity). It measures the probability that two individuals randomly selected from a sample belong to different species. A higher value indicates greater diversity in the community.

$$D = 1 - \sum (p_i^2)$$

p_i = proportion of individuals of species i out of the total number of individuals sampled.

Species constancy (formula below) determines how regularly a species is present in the community across all localities where sampling was conducted.

$$C = \frac{100 \times p}{P}$$

C = species constancy, expressed as a percentage.

p = number of surveys containing the species in the surveyed localities.

P = total number of surveys across all surveyed localities.

If $C \geq 50\%$, the species is constant.

If $25\% \leq C < 50\%$, the species is accessory.

If $C < 25\%$, the species is accidental.

RESULTS

1. Diagnosis of UTSO of Collected Edible Land Snails



Achatina sp1a

Fig. 3. *Achatina sp1a*: Medium to large size; brownish to yellowish coloration; medium to large dark or reddish-brown zigzag stripes on the outer and inner surfaces of the operculum.



Achatina sp1b

Fig. 4. *Achatina sp1b*. Medium to large size; brownish, grayish, and yellowish coloration; dark zigzag stripes on the outer and inner surfaces of the operculum; horizontal stripes on the inner surface of the operculum.



Achatina sp2a

Fig. 5. *Achantina sp2a*. Medium to large size; brownish, grayish, and yellowish coloration; large reddish-brown stripes arranged vertically and others in a zigzag pattern, running horizontally on the inner surface of the operculum.



Achatina sp2b

Fig. 6. *Achatina sp2b*. Medium to large size; brownish and yellowish coloration; large reddish-brown stripes arranged in a zigzag pattern along the entire length of the shell.



Achatina sp2c

Fig. 7. *Achatina sp2c*. Medium to large size; brownish, grayish, and yellowish coloration; medium to large dark stripes arranged vertically and others in a zigzag pattern running vertically on the operculum.



Achatina sp2d

Fig. 8. *Achatina sp. 2d*. Medium to large size; brownish, grayish, and yellowish coloration; medium reddish-brown stripes arranged vertically and others in a zigzag pattern running horizontally on the inner surface of the operculum.



Achatina sp3
Route Ituri, PK 110 ; 10-05-2015

Fig. 9. *Achatina* sp. 3. Medium to large size; blackish-green coloration, with greenish tones dominating along the spirals at the apex; fine stripes aligned along the vertical axis of the spirals; shell interior bluish.



Achatina sp4

Fig. 10. *Achatina* sp. 4. Medium to large size; blackish to reddish coloration; medium to large vertical stripes running on the inner surface of the operculum.



Achatina sp5

Fig. 11. *Achatina* sp. 5. Medium to large size; brownish coloration; dark stripes arranged horizontally on the outer and inner surfaces of the last whorl.



Achatina sp6

Fig. 12. *Achatina* sp. 6. Medium to large size; brownish coloration; dark vertical stripes covering the entire shell; horizontal stripes on the inner surface of the operculum.



Achatina sp7

Fig. 13. *Achatina* sp. 7. Medium to large size; reddish coloration; reddish stripes arranged vertically, discontinuous, sometimes visible and sometimes not.



Achatina cf. *stuhlmanni* sp2

Fig. 14. *A. cf. stuhlmanni* sp. 2. Medium size; greenish coloration; no stripes along the entire length of the shell except at the apex.



Achatina sp9

Fig. 15. *Achatina* sp. 9. Small size; brownish coloration; blackish stripes; a raised circular line giving a broken appearance along the length of the first whorl, dividing it into two parts.



Archachatina cf. marginata

Fig. 16. *Archachatina* cf. *marginata*. Large size; shell less pointed with pronounced roundness; fine lines aligned along the vertical axis of the spirals; shell interior colored dark pink to red.

2. Averages of Measurements and Number of Whorls of the Different UTSO

The averages of measurements and the number of whorls for the different UTSO are presented in Table 1.

Table 1: Averages of measurements and number of whorls of the 13 recorded UTSO

UTSO	Pd	H	W	Al	aw	bwl	las3w	LO3ds	NS
<i>Achatina</i> sp1a	138,6	120,6	53,6	62,2	42,9	86,4	107,2	50,3	7
<i>Achatina</i> sp1b	139,0	120,5	53,6	62,2	42,9	86,3	107,1	50,4	7
<i>Achatina</i> sp2a	139,6	120,4	53,5	62,1	42,9	86,2	107,1	50,3	7
<i>Achatina</i> sp2b	138,5	120,5	53,5	62,2	42,9	86,2	107,1	50,2	7
<i>Achatina</i> sp2c	139,4	120,2	53,4	62,0	42,9	86,0	106,8	50,2	7
<i>Achatina</i> sp2d	139,1	120,4	53,5	62,1	42,9	86,2	107,1	50,3	7
<i>Achatina</i> sp4	142,5	120,3	53,4	62,2	43,3	86,1	107,2	50,4	7
<i>Achatina</i> sp5	143,2	120,1	53,1	62,1	43,3	85,9	107,0	50,3	7
<i>Achatina</i> sp6	127,9	114,5	50,8	59,4	41,0	81,4	101,9	48,1	7
<i>Achatina</i> sp7	130,4	117,6	51,9	60,9	41,3	83,6	104,5	48,9	7

<i>Achatina cf. stuhlmanni</i> sp2	47,3	114,0	49,0	56,3	33,7	80,7	100,7	46,7	7
<i>Achatina</i> sp9	64,5	90,2	42,2	48,9	33,9	65,8	80,8	38,0	6
<i>A. cf. marginata</i>	171,6	102,3	59,8	69,9	48,9	89,0	99,5	38,9	4

Legend: UTSO = Operational Taxonomic Units at the species level; H = shell height; W = shell width; Al = operculum length; aw = operculum width; bwl = body whorl height; las3w = height of the last three whorls; LO3ds = length from the tip of the operculum to the last three whorls; NS = number of whorls.

Table 1 shows that the UTSO *Achatina* sp. 1 (a-b), *Achatina* sp. 2 (a-d), *Achatina* sp. 4, *Achatina* sp. 5, *Achatina* sp. 6, *Achatina* sp. 7, and *Achatina cf. stuhlmanni* sp. 2 have 7 whorls, except for *Achatina* sp. 8, which has 6 whorls, while for the genus *Archachatina*, there are 4 whorls. The total shell length, total width, operculum length and width, as well as whorl lengths and the distance between the operculum and the third whorl, vary around 120 mm, 53 mm, 62 mm, 42 mm, 86 mm, and 50 mm, respectively. For *Achatina* sp. 6 and *Achatina cf. stuhlmanni* sp. 2, only certain measurements vary, particularly the operculum length and the distance from the start of the operculum.

3. Ecological Indices According to Road Axes

The calculations of ecological indices for the two road axes are provided in Table 2.

Table 2. Presentation of survey results based on ecological indices

Road axis	RS	Shannon $H\alpha'$	Simpson 1-D	Equitability J
Kisangani-Ituri	6	1,45	0,72	0,81
Kisangani-Ubundu	8	1,42	0,69	0,68

Table 2 shows that species diversity is high along each road axis ($H'\alpha = 1.45$ on the Kisangani–Ituri road axis, RS = 6 UTOS, and $H'\alpha = 1.42$ on the Kisangani–Ubundu road axis, RS = 8 UTOS). The evenness index indicates that species are similarly distributed along each road axis ($E_q = 0.81$ for the Kisangani–Ituri road axis; $E_q = 0.68$ for the Kisangani–Ubundu road axis). As for Simpson’s diversity index, it shows a high probability of finding two individuals belonging to two different species along each road axis ($D = 0.72$ for the Kisangani–Ituri road axis; $D = 0.69$ for the Kisangani–Ubundu road axis).

3. Relative Abundance and Constancy of UTSO on the Two Road Axes

The results are presented in Table 3.

Table 3. Distribution of UTSO of edible terrestrial snails recorded along the Kisangani–Ituri and Kisangani–Ubundu road axes

Localités / UTSO	<i>Achatina</i> sp1a	<i>Achatina</i> sp1b	<i>Achatina</i> sp2a	<i>Achatina</i> sp2b	<i>Achatina</i> sp2c	<i>Achatina</i> sp2d	<i>Achatina</i> sp4	<i>Achatina</i> sp5	<i>Achatina</i> sp6	<i>Achatina</i> sp7	<i>A. cf. stuhlmanni</i> sp2	<i>Achatina</i> sp9	<i>A. cf. marginata</i>	Total	%
Axe Kisangani-Ituri															
Baliambobi	7	1	3	0	0	1	9	3	0	0	0	0	0	24	24,2
Banakanuke	2	1	5	2	16	4	10	1	0	0	0	0	0	41	41,4
Basenge	7	0	0	0	4	0	4	0	2	0	0	0	0	17	17,2
Basugo	0	0	0	0	0	0	0	0	0	0	0	0	8	8	8,1
Basukwambula	0	1	2	1	2	0	3	0	0	0	0	0	0	9	9,1
S/total	16	3	10	3	22	5	26	4	2	0	0	0	8	99	100,0
Constance	60	60	60	40	60	40	80	40	20	0	0	0	20	**	**
Axe Kisangani-Ubundu															
Babolemba	20	11	3	6	8	12	3	2	0	1	0	0	0	66	25,6
Babutu	2	1	0	1	0	0	0	0	0	0	0	0	0	4	1,6
Kanana	27	18	6	7	5	4	3	3	2	11	0	3	0	89	34,5
Lusa	9	1	0	1	1	1	0	0	0	4	0	0	0	17	6,6
Mbokamalili	1	0	0	1	1	0	0	0	0	1	3	0	0	7	2,7
Obilo	7	9	6	10	6	2	7	5	4	7	0	0	0	63	24,4
Yoko	3	1	2	1	3	2	0	0	0	0	0	0	0	12	4,7
S/total	69	41	17	27	24	21	13	10	6	24	3	3	0	258	100
Constance	100	85,7	57,1	100,0	85,7	71,4	42,9	42,9	28,6	71,4	14,3	14,3	0,0	**	**
Total général	85	44	27	30	46	26	39	14	8	24	3	3	8	357	100

Table 3 shows that, out of a sample of 357 purchased edible terrestrial snails, 27.7% came from the Kisangani–Ituri road axis and 72.3% from the Kisangani–Ubundu road axis. These snails belong to two genera, *Achatina* and *Archachatina*, and comprise 13 UTSO: *Achatina* sp1(a–b), *Achatina* sp2(a–d), *Achatina* sp4, *Achatina* sp5, *Achatina* sp6, *Achatina* sp7, *Achatina* cf. *stuhlmanni* sp2, *Achatina* sp9, and *Archachatina* cf. *marginata*. The UTSO *Achatina* sp1(a–b) and *Achatina* sp2(a–d) were the most abundant on both road axes.

Along the Kisangani–Ituri road axis, snails were distributed among 9 UTSO. They were most abundant in the locality of Banakanuke (41.4%), followed by Baliambobi (24.2%), and least abundant in Basugo (8.1%). Three UTSO had a high number of individuals: *Achatina* sp4 (26 specimens), *Achatina* sp2c (22 specimens), and *Achatina* sp1a (16 specimens). UTSO with few individuals included *Achatina* sp6 (2 specimens), *Achatina* sp1b (3 specimens), and *Achatina* sp2b (3 specimens).

Snails from the Kisangani–Ubundu road axis comprised 12 UTSO, with the exception of *Archachatina* cf. *marginata*. Along this axis, three localities supplied most of the edible terrestrial snails: Kanana (34.5%), Babolemba (25.6%), and Obilo (24.4%). The localities of Babutu (1.6%) and Mbokamalili (2.7%) supplied few snails. *Achatina* sp1 (110 specimens), including *Achatina* sp1a (69 specimens) and *Achatina* sp1b (89 specimens), were the best represented in the collection. *Achatina* sp2(a–d) ranked second with 89 specimens. In contrast, *Achatina* sp8 and *Achatina* sp9 were each represented by only three specimens.

4. Constancy of UTSO according to the Kisangani–Ubundu and Kisangani–Ituri Road Axes

It emerges from Table 4 that along the Kisangani–Ituri road axis, *Achatina* sp1 (a–b), *Achatina* sp2 (a, c), and *Achatina* sp4 are constant UTSO. Meanwhile, *Achatina* sp2 (b, c) and *Achatina* sp5 are accessory UTSO. Finally, *Achatina* sp6 and *Achatina*. cf. *marginata* are accidental UTSO.

Table 3 also indicates that along the Kisangani–Ubundu road axis, *Achatina* sp1 (a–b), *Achatina* sp2 (a–d), and *Achatina* sp7 are constant UTSO. *Achatina* sp4, *Achatina* sp5, and *Achatina* sp6 are accessory UTSO. Finally, *Achatina* cf. *stulhmanni* sp2 and *Achatina* sp9 are accidental UTSO.

DISCUSSION

Ecological Indices according to Road Axes

The results showed that the species diversity of edible terrestrial snails is high along both road axes considered (Kisangani–Ituri road axis: $H'\alpha = 1.45$; 6 UTSO; Kisangani–Ubundu road axis: $H'\alpha = 1.42$; 8 UTSO). With regard to Simpson's diversity index ($D = 0.72$ for the Kisangani–Ituri road axis and $D = 0.69$ for the Kisangani–Ubundu road axis), the results indicate a high probability of finding two individuals belonging to two different species along both road axes. Finally, the evenness index shows that species are similarly distributed along the two axes ($Eq = 0.81$ for the Kisangani–Ituri road axis and $Eq = 0.68$ for the Kisangani–Ubundu road axis).

Arakayo (2010) pointed out that the Kisangani–Ubundu road axis ranks first in supplying the central market of Kisangani with edible terrestrial snails. Makanda (1980) also noted that the Kisangani–Ubundu road axis supplies the central market of Kisangani not only with vertebrate game but also with invertebrates, including a large quantity of edible terrestrial snails. Our observations corroborate those of these authors, as a large proportion of edible terrestrial snails sold in the various markets of Kisangani, including the central market, originate from this axis. However, from the standpoint of diversity, snails are diversified along both road axes.

Generic and/or Species Diversity

Except for *Achatina*. cf. *marginata*, which was not recorded, edible terrestrial snails collected along the Kisangani–Ubundu road axis belonged to the genus *Achatina*, with a total of 12 UTSO: *Achatina* sp1 (a–b), *Achatina* sp2 (a–d), *Achatina* sp4, *Achatina* sp5, *Achatina* sp6, *Achatina* sp7, *Achatina* sp8, and *Achatina* sp9.

Along the Ituri–Kisangani road axis, the genus *Achatina* was recorded with 10 UTSO: *Achatina* sp1 (a–b), *Achatina* sp2 (a–d), *Achatina* sp4, *Achatina* sp5, and *Achatina* sp6. In addition, the genus *Archachatina* was represented by a single UTSO (*Achatina*. cf. *marginata*).

Aboua *et al.* (1996) reported two genera of snails in West Africa: *Achatina* (*A. schweinfurthi*, *A. bandeirana*) and *Archachatina*. These differ from the species found in the Kisangani region due to ecological barriers formed by major rivers and the preliminary sequencing carried out (Fuka, 2017). Kebolo *et al.* (2014) conducted a study on the ecology and diversity of African giant snails in Mbandaka, Kinshasa, Mai-Ndombe, and Central Congo in the DRC over a five-year period. They collected 754 snails belonging to two genera: *Achatina* with five species (*A. fulica*, *A. weynsi*, *A. bandeirana*, *A. stuhlmannii*, and *A. balteata*), and *Archachatina* with a single species (*A. marginata*) and two subspecies (*A. suturalis* and *A. ovum*). These findings highlight the need to refine the identification of snails from the Kisangani region to allow for accurate comparisons of species diversity.

Lifoli (2021) conducted a study on the inventory, social representations, and value chain of edible terrestrial snails in the Yangambi landscape. This study collected 668 snails belonging to three genera (*Achatina*, *Burtoa*, and *Limicolaria*), with a total of 13 UTSO, of which *Achatina* was the most diversified with 8 UTSO, followed by *Limicolaria* with 4 UTSO and *Burtoa* with 1 UTSO. *Achatina* and *Archachatina* are the two genera reported both in our study and in Kebolo *et al.* (2014). The observed difference in species richness is attributed to the number of years of sampling between the two studies, the geographical locations investigated, and the identification methods used.

In common, Kebolo *et al.* (2014) and Lifoli (2021) recorded edible terrestrial snails belonging to the genus *Achatina*. Our study also found that all UTSO of the genus *Achatina* occurred along both road axes, except for *Achatina* sp7, *A. cf. stuhlmannii* sp2, and *Achatina* sp9. Basugo was the only locality along the Kisangani–Ituri road axis where *A. cf. marginata* was recorded. This difference can be explained, on the one hand, by the small sample size obtained along the Ituri axis and, on the other hand, by the fact that the Congo River may constitute an ecological barrier for *A. cf. marginata*.

Relative Abundance and Constancy

The study sample consisted of 357 snails. Two genera (*Achatina* and *Archachatina*) were inventoried, comprising a total of 13 UTSO, with 12 UTSO belonging to the former genus and only one to the latter, which was recorded exclusively along the Kisangani–Ituri road axis. Along the Kisangani–Ituri road axis, 10 UTSO were recorded: *Achatina* sp1 (a–b), *Achatina* sp2 (a–d), *Achatina* sp4, *Achatina* sp5, *Achatina* sp6, and *A. cf. marginata*. The Kisangani–Ubundu road axis was the most diversified in terms of snails, with 12 UTSO: *Achatina* sp1 (a–b), *Achatina* sp2 (a–d), *Achatina* sp4, *Achatina* sp5, *Achatina* sp6, *Achatina* sp7, *Achatina cf. stuhlmannii* sp2, and *Achatina* sp9.

On both road axes, *Achatina* sp1 (a–b) and *Achatina* sp2 (a–d) were the most abundant UTSO and were also constant, whereas *Achatina* sp5 was accessory on both axes. Along the Ituri axis, *Achatina* sp6 and *A. cf. marginata* were less abundant and accidental, while along the Ubundu axis, *Achatina* sp4 and *Achatina* sp5 were accessory, whereas *Achatina cf. stuhlmannii* sp2 and *Achatina* sp9 were poorly represented and accidental.

The observations made for *Achatina* sp1 (a–b) and *Achatina* sp2 (a–d) are consistent with those reported by Fuka (2017). However, these UTSO were less represented in the Yangambi landscape, where small- to medium-sized snails dominate (*Achatina cf. stuhlmannii*, *Limicolaria* sp) (Lifoli, 2021). The observed differences in abundance may be explained by variations in environmental conditions, suggesting that habitat plays an important role in snail abundance. Indeed, differences in diversity may be attributed to environmental factors (rainfall, forest type) that are not uniform across sites, as well as to the limited number of collectors along the Ituri axis, where hunting of game species is the predominant activity.

These results highlight the role of the Kisangani region as an area rich in edible terrestrial snail diversity, similar to Cameroon, Gabon, Nigeria, Ghana, and Côte d'Ivoire. In the regional context, the Kisangani region should be part of a dynamic framework in which snail farming and consumption play a key role in food security and resilience to climate change. The Democratic Republic of the Congo, and particularly the Kisangani region, has significant potential to be enhanced through research, sustainable management, and the integration of edible terrestrial snails into the African regional socioeconomic system.

CONCLUSION

The study clarified the diversity of edible terrestrial snails along the two road axes Kisangani–Ituri (10 UTSO) and Kisangani–Ubundu (12 UTSO), with 9 UTSO common to both axes: *Achatina* sp1 (a–b), *Achatina* sp2 (a–d), *Achatina* sp4, *Achatina* sp5, and *Achatina* sp6.

A. cf. marginata was recorded only along the Kisangani–Ituri road axis, whereas *Achatina* sp7, *Achatina cf. stuhlmannii* sp2, and *Achatina* sp9 were found exclusively along the Kisangani–Ubundu road axis. The UTISO dominating both axes were *Achatina* sp1 (a–b) and *Achatina* sp2 (a–d).

These results confirm (1) that the Kisangani region is a rich area in edible terrestrial snail diversity, and (2) its enormous potential for enhancement through research, sustainable management, and the integration of edible terrestrial snails into the socio-economic system for the development of local communities.

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