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Identification of Edible Caterpillar Plants Planted in FAS in Ibi-Village on The Batéké Plateau, Kinshasa, DRC

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ABSTRACT

A study on the toothing of edible caterpillar plants planted with FAS in Ibi- a village on the Batékéen Plateau the Democratic Republic of Congo. The main objective of this study was to identify and characterize the species of edible caterpillar plants planted in Ibi-village on the Batéké plateau. To do so, we used observation as a research method. In this study, 35 species of edible caterpillar host plants were identified, divided into 16 families and 7 orders. Regarding the ecological spectra of florule, Mesopotamians and sarcochores are predominant. On the phytogeographical level, the strong representativeness of the Guineo-Congolese element. Morphologically, the majority of species are trees. In this study, Pentaclethra eetveldeanaes the most dominant species. The most represented families are those of Fabaceae et Euphorbiaceae.

INTRODUCTION

In the DRC, the degradation of forest ecosystems is increasingly observed around large cities, up to a radius of more than 150 kilometers in some cases (MALELE, 2003; MALAISSE *et al.*, 1985). The forest galleries disappear because energy wood, PFL, and PFNL are supplied to these agglomerations.

The dense forest is the subject of an uncontrolled exploitation that can lead to environmental changes throughout the national territory (MALOBA, 2011).

Some initiatives developed around Kinshasa (Mampu and Ibi-village projects) do not cover the wood and energy needs of this large city, which has an estimated population of more than 15 million inhabitants in 2020.

These fires are early during the small dry season (mid-January and February) and late during the large dry season (May and September). They, therefore, present the only anthropogenic factor that undoubtedly hinders the progression of the forest (DEFORESTA, 1990). This situation hinders the natural regeneration of the forest species that have colonized these savannahs during their history, of which there are still obvious witnesses on the Batéké plateau.

Over the past decade, recognition of the role of edible non-timber forest products (NWFPs) in food security such as game, fruit, and local mushrooms has increased significantly. Nevertheless, the food potential of edible insects is poorly understood, although several studies have shown that insects contribute significantly to the livelihoods of rural and urban areas.

The richness and diversity of the host plants of edible caterpillars present, both in production forests and in galleries, wooded herbaceous formations and low herbaceous grassy formations, and at the plantation level is an asset whose sustainable management must stimulate its sustainability. The collection and exchange of edible caterpillars remains an informal activity, their marketing provides an interesting but previously underestimated economic complement (N'GASSE, 2003).

LITERATURE REVIEW

The work of OFAC (2012) and Megevand (2013) put forward a general hypothesis: the human impact is one of the main drivers of deforestation, leading to significant transformations in the structure and appearance of landscapes over time.

Several species of edible caterpillars spread throughout the Congolese territory are periodically harvested by communities and are present in most Congolese markets. According to MONZAMBE (2002), more than 85% of the population consume it (fresh, dried or smoked).

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The Ibi-village site is located on the Batéké plateau, which belongs administratively to the urban-rural commune of Maluku, in the province of Kinshasa. It is located 140 km east of the centre of Kinshasa between 4° 15' and 4° 25' south latitude and 16°4' and 16°12' east longitude. The triangular-shaped Ibi-village station covers more than 20,000 ha.

It is bounded to the south by the road linking Kinshasa-Kikwit (the national No. 1), to the west and to the east by the Duale and Lufimi rivers. It is reached 8 km

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from National Road No. 1, easily accessible by a road. Historically, this area was sparsely populated by the Teke ethnic group: about three inhabitants per square kilometer. Traditional authority is exercised by customary chiefs whose role in modern law is not clearly defined in judicial and land matters. Public order, hygiene, health, education, communications are the responsibility of the territorial authority (BISIAUX *et al.*, 2009).

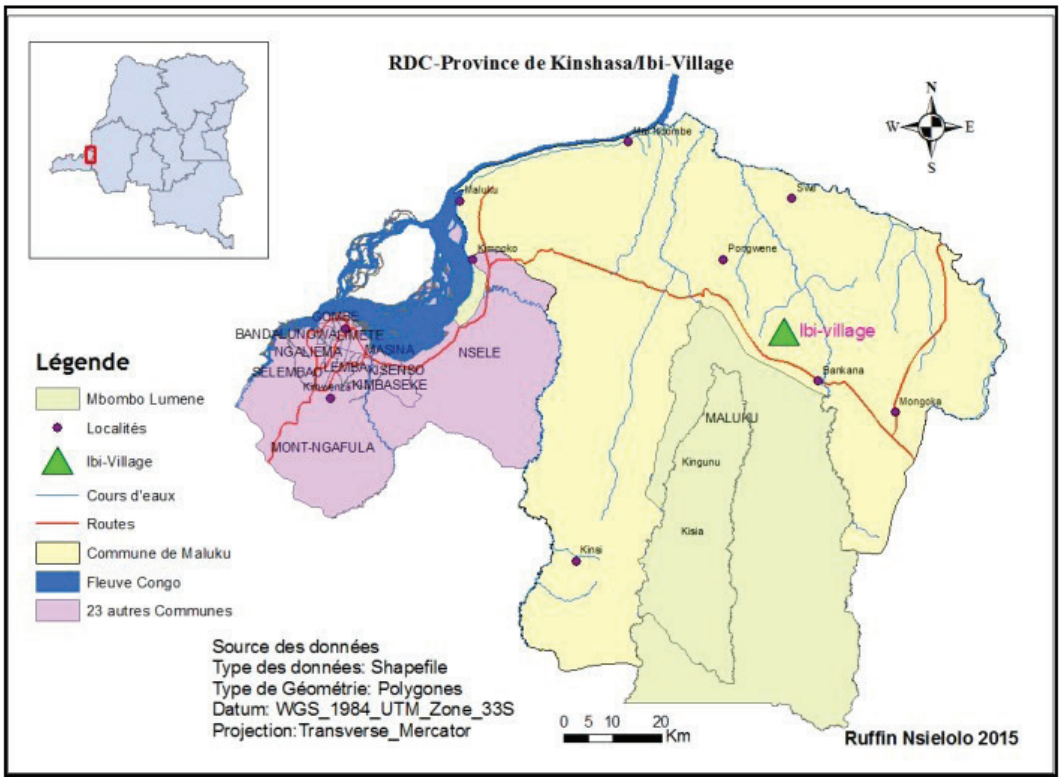

Figure 1: Location of Ibi-village (from NSIELOLO, 2015)

MATERIALS AND METHODS

The biological material used in this study consists mainly of herbarium samples of 35 species of caterpillar plants planted in the SAF of Ibi-village.

The following tools were used for this study:

- Machete: which allowed us to open passages.
- Pruning shears: to take herbarium samples.
- A tape measure: to take the circumference of the trees.
- 1.30 cm cane meter: to take the height of trees 1.30 m from the ground.
- A techno camon 12 mobile phone with on-board camera: to capture photos
- A computer: for writing this work
- A 10 m bamboo: to take the height of the trees
- A research book: to record our field surveys
- A pen: to write our field surveys
- Newspaper, cardboard and a wooden frame: to make our herbarium.

METHODOLOGY

Our working methodology is based on observation. These observations focused on the identification of caterpillar plants, biological type, diaspore type, foliar type, morphological type and harvest of the fewone said plants host of the caterpillars it followed the processing and analysis of its data to have results.

To do this, we have proceeded as follows:

Direct Field Observation

Site Prospecting

With the help of the research certificate obtained from the Dean of the Faculty of Sciences, observations and visits were organized from 26 to 12 November 202» at the Plateau des Batéké more precisely in Ibi-village in the Commune Urbano-rural Maluku, in the city of Kinshasa. These visits were carried out with the aim of recognizing the study area in order to collect information relating to the topic under discussion. These are aspects related to climatic factors, edaphic, etc.

Floristic Inventory

The floristic inventory was made on all edible caterpillar plants planted in the agroforestry system of Ibi-village.

Species Identification

The botanical samples collected were submitted for identification to the laboratory of Systemic, Biodiversity, Nature Conservation and Endogenous Knowledge using the flora of Africa, Cameroon, Rwanda – Urundi (vol. I to X and certain parts). These samples were classified according to APG II, III, and IV.

Autoecological Characteristic

Phytogeographic Distribution (D.P)

The phytogeographic groups of the inventoried species make it possible to determine the phytogeographic position of our study. Referring to the phytogeographical subdivisions of Central Africa, as proposed by WHITE (1979,1986), we have selected the following categories:

Guineo-Congolese (G.C)

Observed throughout the Guineo-Congolese region or pluri-national species; ex: Martretia quadricornis Beille.

Pantropicales (Pan)

Species rependue in Africa, America, tropical Asia and Australia (intertropical region). Ex: *Ceiba pentandra* (L.) Gaertn

Lower Guinean-Congolese (BGC)

Present in the Lower Guinean and Congolese sub-centres; distributed from Nigeria to the Democratic Republic of the Congo, e.g. Staudtia kamerunensis Warb. var. gabonensis (Warb.) Fouilloy.

Afro-Tropical (A.T)

Encountered in several phytochoria in continental tropical Africa. Ex: Pseudospondias microcarpa (A. Rich) Engl.

Centre Guinéo-Congolais (CGC)

Is a species with a range of tributes not reaching the upper Guinean domain.

Biological Type (T.B)

Biological types are examined to determine adaptive strategies and vegetation physiognomy. In our work, we adopted the biological types defined according to the classification of RAUNKIAER (1934) modified by LEBRUN (1947) namely:

✗Mesophanerophyte (MsPh): Trees with organs between 10 and 30 m above the ground

✗Megaphanerophyte (MgPh): Trees whose organs are located above 30 m of the ground.

Type of Diaspore (T.D)

Diaspore types provide information on how species are disseminated. 4 categories of diaspore defined by DANSEREAU & LEMS (1957) have been chosen for our work, these are:

- Ballochores (Ballo): Diaspores expelled by the plant itself,
- Bogonochores (Pugno): Diaspores with feathery or silky appendages, double-crested hairs
- Barochores (Baro): dry or fleshy, heavy diaspores
- Sarcochores (sarco): totally or partially fleshy diaspores.

Type Foliaire (T.F)

The types of foliar sizes were inspired by RAUNKIAER (1934), taken up by many authors, including MALAISSE (1976), LUBINI (1997,2001), MASSENS (1997), NSHIMBA (2008), BELESI (2009), HABARI (2009) and RUELLE & MALAISE (2016).

These are the following types:

- Mesophylls: leaf area between 20 to 200 cm² (2 dm²),
- Leptophylles: leaf area less than 0.2 cm²,
- Megaphylls: leaf area greater than 0.16 m²
- Macrophylls: 2 to 200 dm²
- Nanophylls: 0.2 to 2 cm²
- Microphylles: 2 to 20 cm²

Morphological Type (T.M)

Morphological spectra identified in phytosociological surveys were determined in the field and verified using the computerized catalogue of LEJOLY *et al.* (1988).

The morphological types chosen for this work are:

Tree (A)

species with woody stem, large size with the presence of axillary buds that rise several meters.

Shrub (Arb)

species with a woody stem, of small size generally with the absence of axillary buds growing a few meters and branching at their base.

Data Analysis and Interpretation

For data processing and interpretation, we used Microsoft Word, Excel and some statistical analysis.

For statistical analyses, we analysed the following parameter according to BILOSO (2021):

Percentage (%)

Calculated by dividing the frequency (f) of each individual by the total number (N) of all individuals multiplied by 100.

$\% = (f * 100)/N$ (1)

RESULTS AND DISCUSSION

RESULTS

Plants with Edible Caterpillars

Plants with edible caterpillars planted in Ibi-village are recorded in Table 2.

Table 1: Diversity of host plants with domesticated caterpillars in Ibi-village

Order	Family	Species
Asterales	Asteraceae	*Vernonia brazzavilensis* Schreb.
Fabales	Fabaceae	*Afzelia bipendensis* Harms.
		Afzelia bella Harms.
		Albizia adianthifolia Benth.
		Berlinia giorgii Sol. Hook.f.

		Millettia drastica Wight & Arn.
		Millettia laurentii De wild.
		Millettia versicolor Wight & Arn.
		Pentaclethra eetveldeana De wild. T. Durand Pentaclethra macrophylla Benth.
Gentianales	Apocynaceae	*Funtumia elastica* (preuss) stapf.
		Picralina nitida (stapf) T. Durand & H. Durand.
	Loganiaceae	*Anthocleista schweinfurthii* Gilg.
Malpighiales	Rubiaceae	*Sarcocephalus latifolius* (Sm) E.A. *Bruce. Nauclea diderrichii* Merr.
Malpighiales	Euphorbiaceae	*Aleurites mollucana* (L.) wild.
		Bridelia feruginea Benth.
		Hymenocardia ulmoides Wall & Lindl.
		Macaranga spinosa Thouars.
		Ricinodendron heudelotii Müll. Arg.
		Uapaca guineensis Müll. Arg.
	Flacourtiaceae	*Oncoba welwitschii* Forssk.
	Irvingiaceae	*Irvingia gabonensis* Baill.
	Clusiaceae	*Symphonia globulifera* L.f.
Malvales	Malvaceae	*Ceiba pentandra* L.
Myrtales	Myrtaceae	*Syzygium guineensis* (Wild).
Sapindales	Burseraceae	*Canarium schweinfurthii* Engl.
		Dacryodes edulis (G. Don) H.J. Lam.
	Anacardiaceae	*Lannea antiscorbutica* A. Rich.
	Meliaceae	*Entandrophragma angolense* (Welw.) *C.DC. Entandrophragma candollei* Harms.
Hives	Moraceae	*Milicia excelsa* (Welw.) C.C Berg.
		Cercopia peltata L.
		Trilepsium madagascariensis DC.
Rosales	Rhamnaceae	*Maesopsis eminii* Engl.

The analysis of the above table shows that 35 species of plants with edible caterpillars were listed and belonging to 7 orders and in 16 families. The orders of Fabales et Malpighialessont better represented with 9 species each, followed by Sapindaleswith 5 species and that of Gentianalesavec 3 species and the others are weakly represented. From the family point of view, those of Fabaceaeand Euphorbiaceae are dominant and have respectively 9 and 5 species and the others are poorly represented.

Density of Edible Caterpillar Host Plants Planted in FAS in Ibi-Village

The quantitative analysis of inventoried species is shown in Table 2 below.

Table 2: Quantitative analysis of host plants of domesticated edible caterpillars in FAS in Ibi-village

N°	SPECIES	Family	f	%
1	*Afzelia bipendensis* Harms.	Fabaceae	4	2
2	*Afzelia bella* Harms.	Fabaceae	8	4
3	*Albizia adianthifolia* Benth.	Fabaceae	2	1
4	*Aleurites mollucana* (L) wild.	Euphorbiaceae	9	5
5	*Anthocleista schweinfurthii* Gild.	Loganiaceae	2	1
6	*Berlinia giorgi* Sol.	Fabaceae	11	5,7
7	*Bridelia feruginea* Benth.	Euphorbiaceae	1	0,5
8	*Canarium schweinfurthii* Engl.	Burseraceae	8	4
9	*Ceiba pentandra* L.	Malvaceae	3	1,5

10	*Cercopia peltata* L.	Moraceae	1	0,5
11	*Dacryodes edulis* (G. Don) H.J Lam.	Burseraceae	4	2
12	*Entandrophragma angolense* (welw.) C. DC.	Meliaceae	3	1,5
13	*Entandrophragma candolleii* Harms.	Meliaceae	2	1
14	*Funtumia elastica* (Preuss) stapf.	Apocynaceae	12	6,2
15	*Hymenocardia ulmoïdes* Wall & Lindl.	Euphorbiaceae	1	0,5
16	*Irvingia gabonensis* Baill.	Irvingiaceae	6	3,1
17	*Lannea antiscorbutica* A. Rich.	Anacardiaceae	1	0,5
18	*Macaranga spinosa* Thouars.	Euphorbiaceae	2	1
19	*Maesopsis eminii* Engl.	Rhamnaceae	12	6,2
20	*Milicia excelsa* (Welw) C.C Berg.	Moraceae	16	8
21	*Millettia drastica* Wight & Arn.	Fabaceae	1	0,5
22	*Millettia laurentii* De wild.	Fabaceae	1	0,5
23	*Millettia versicolor* Wight & Arn.	Fabaceae	2	1
24	*Nauclea diderrichii* Merr.	Rubiaceae	4	2
25	*Oncoba welwitschii* Forssk.	Flacourtiaceae	1	0,5
26	*Pentaclethra eetveldeanaFr wild. T. Durand.*	Fabaceae	39	20,1
27	*Pentachletra macrophylla* Benth.	Fabaceae	9	5
28	*Picralina nitida* (stapf) T. Durand & H. Durand.	Apocynaceae	1	0,5
29	*Ricinodendron heudelotii* Müll. Arg.	Euphorbiaceae	9	5
30	*Sarcocephalus latifolius* (Sm) E. A. Bruce.	Rubiaceae	1	0,5
31	*Symphonia globulifera* L. f.	Clusiaceae	1	0,5
32	*Syzygium guineensis* (wild).	Myrtaceae	1	0,5
33	*Trilepsium madagascariensis* DC.	Moraceae	7	3,6
34	*Uapaca guineensis* Müll. Arg.	Euphorbiaceae	5	2,6
35	*Vernonia brazzavilensis* Schreb.	Asteraceae	4	2
Total			**194**	**100**

Caption: f: Frequency, %: Percentage

Table 2 shows the dominance of Pentaclethra eetveldiana with 39 individuals or 20.1% followed by Milicia excelsa with 16 individuals or 8% then Maesopsis eminii and Funtumia elasticaSuivent with 12 individuals each or 6.2% and the others are poorly represented.

Autoecological Characteristics of Plants with Edible Caterpillars Plants in Ibi

The autoecological characteristics of edible caterpillar plants planted in ibi-village FAS are presented in this point.

Phytogeographic Distribution

It is in Figure 2 that the different geographical distributions of the caterpillar species planted in Ibi-village are expressed.

In the analysis of Figure 2, we note the dominance of the species belonging to the regional center of Guineo-Congolese endemism at 54.4% or 19 species followed by afrotropical and low-Guineo-Congolese species (17.1% each), the pantropical species (5.7%) and the species of the Guineo-Congolese and African-American center are

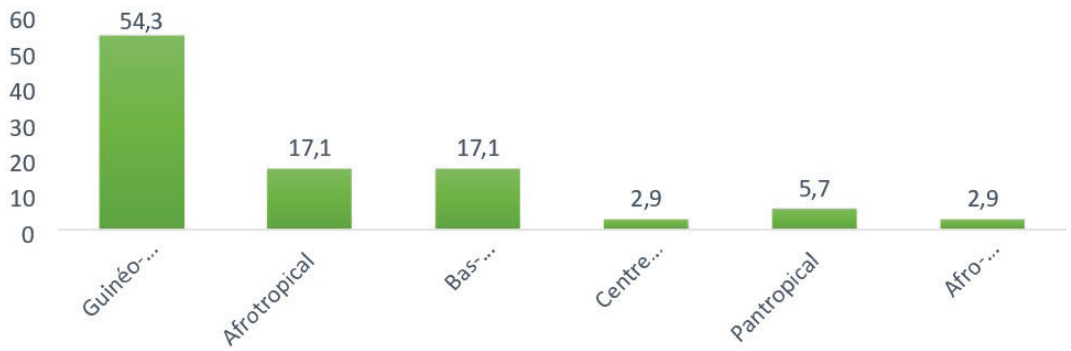

Figure 2: Phytogeographic spectra of caterpillars species studied

poorly represented with 2.9% each (or 1/35 species each). Donc les espèces qui caractérisent cette plantation sont celles du centre régional d'endémisme guinéo-congolais.

Biological Types

The analysis of the biological types of species is shown in the figure below.

Figure 3: Ibi-village FAS Caterpillar Host Plant Biological Types

An examination of Figure 3 shows the dominance of species Mesophanérophytes (85.7% or 30/35 species) and the other species are Megaphanerophytes or 14.3%.

Types of Diaspores

Figure 4 explains the species belonging to the different types of Diaspores.

From this figure 4, it emerges that sarcochoria is the most dominant mode of diaspore dispersion with 53% of the studied species followed by ballochoria with 31%. Pogonochoria and barochoria are poorly represented with 10% and 6%.

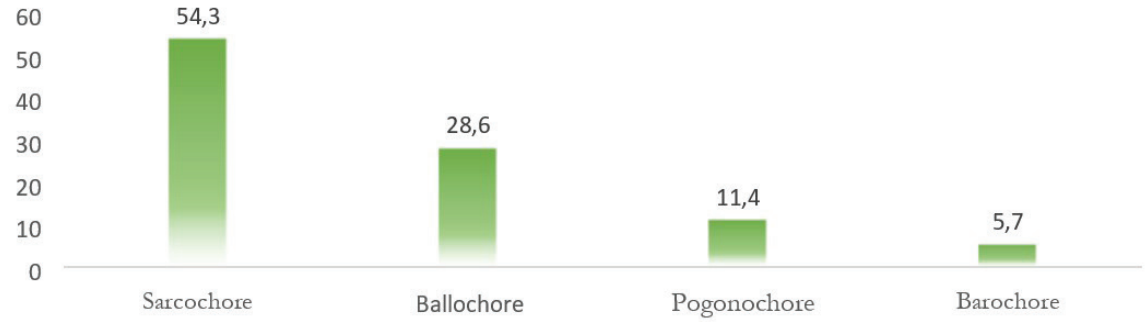

Figure 4: Diaspore types of caterpillars planted with Ibi-village FAS

Foliar Type

The different types of foliar dimensions are shown in Figure 5. It follows from Figure 5 that the Mesophyll species predominate at 65.7%, followed by the Megaphyll species (11.4%), Leptophylles at 8.6%. Macrophylls and Microphylles follow with 5.7% and Nanophylles 2.9%.

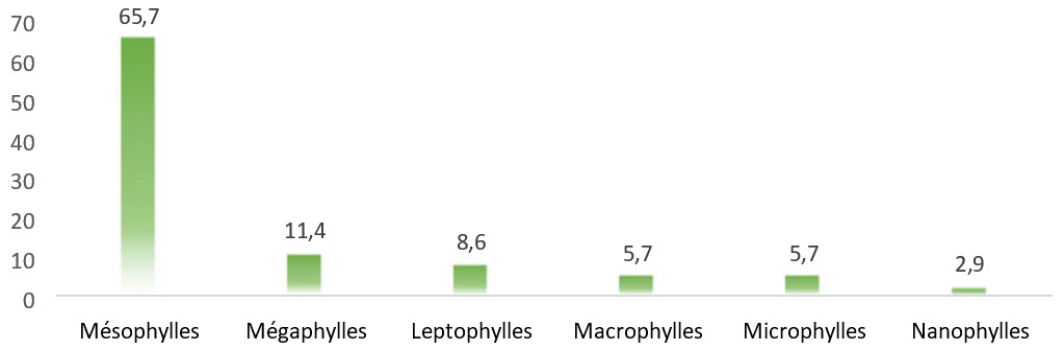

Figure 5: Foliar types of caterpillar trees planted with FAS in Ibi-village

Morphological Types

Two morphological types are unequally represented (Figure 6)

Our analysis shows that the proportion of trees is very dominant with 91.4% while shrubs are less represented (8.6%).

Figure 6: Morphological types of species planted in Ibi-village FAS

DISCUSSIONS

Analysis of the host flora of edible caterpillars reveals 35 plant species belonging to 16 different families, grouped in 7 orders.

Among these families, the most characteristic are the Fabaceae and the Euphorbiaceae having respectively 9 and 6 species. The Fabaceae family is more diverse with 9 different species unlike KIDIKWADI (2012) which reported more species in this family.

The analysis of the species density shows that Pentaclethra eedveldeana has a high density with 39 individuals or 20.1% than the others. Contrary to the results of KIDIKWADI (2012) which shows the dominance of Dialium englerianum with 164 individuals in the region of BomboLumene.

The first position occupied by the family Fabaceae is explained by the high number of individuals that make up these species in the studied environment, also being the environment where the species are better accommodated. Also having protein-rich leaves, caterpillars nest there easily.

It appears from the analysis of the autoecological characteristics that the botanical inventory set contains many Guineo- congolese species or 54.4%.

This is explained by the fact that the Batéké plateau is in the phytochorie of the regional center of Guineo-Congolese endemism or dominates the Bas-Guineo-Congolese element.

Moreover, our analysis highlights that the Mesotrophic species are dominant at 85.7% of the studied flora. This result is contrary to that of KIDIKWAKI which shows the dominance of Microphanérophytes species at 71% in the BomboLumene region.

From the diaspore point of view, the sarcochoric species are numerous or 54.3% of the flora studied. This dominance would be justified by the fact that sarcochoria is the mode of seed dispersal that characterizes many evergreen rainforests (BOYEMBA, 2006 and LOMBE, 2007) where most are consumed by animals. Moreover, it emerges from our analysis that 91.4% of species are trees and very few shrubs. This is the evidence that generally in the intertropical zone many phytophages nest on trees as other morphological forms (BELESI, 2009).

CONCLUSION

Our study on the toothing of edible caterpillar plants planted in fas in ibi- a village on the Bateke plateau in the democratic republic of Congo had as its main objective to identify the different edible caterpillar plants planted in the agroforestry system of ibi-village. And to do so, we used the observation method. At the end of our research, the following conclusions emerge: the results obtained indicate a diversity of 35 species of edible caterpillar host plants that are grouped into 7 orders and 16 families. Pentaclethra eedveldeana is best represented. However, the fabaceae and euphorbiaceae families contain more species than the other families. Sarcochoric species are more dominant compared to the identified types of diaspores. The majority of the species are from the regional center of guineo-congolese endemism. Which justifies the belonging of our diction to this phytochorie. The most dominant foliar types are the mesophylls, which are mostly mesoophanerophytes, characteristic of most species of moist intertropical africa. This study allowed us to highlight a significant diversity of edible caterpillar plants planted in Ibi-village, the performance of these species in height and diameter and also their potential. This study also showed us that we can put our local species in our reforestation projects instead of the species like Acacia auriculiformis because we have species with the same level of performance as the latter and they can be exploited under various forms and especially reforestation with edible caterpillar host plants can be an important source of animal income and protein.

In light of the above, we make a few recommendations:

- The continuation of subsequent studies to capitalize these resources as important for the country ;
- Extending the study to the entire Batéké plateau for the establishment of an atlas of edible caterpillar plants;
- Encouraging awareness of the domestication of local plants and especially caterpillars to sustain species;
- The popularization of the consumption of caterpillars that contribute to the supply of protein and energy foods to health;
- Public awareness of domestication of local plants and especially edible caterpillar host plants
- The involvement of the state in the financing of reforestation projects with local species.

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