

Contribution to the ecological study of edible caterpillars in Gbado-Lite city and its surroundings, Nord-Ubangi, Democratic Republic of the Congo

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Abstract: Among various crops distributed in the world, insects remain a vital and privileged food as well they constitute an essential source of proteins, fats, minerals and vitamins. Caterpillars are among the most consumed and appreciated insects by African communities and particularly by Congolese. A socio-economic survey was conducted among caterpillar suppliers and artisanal wood miners in and around Gbado-Lite Forest in Nord Ubangi Province in order to inventory and identify different species of edible caterpillars in this region and their host plants. The objectives of this survey were to describe the habitats of edible caterpillars and to assess temporal and spatial variations in the abundance of caterpillars at harvest and their edible potential as a source of income for rural households. This study identified 10 species of caterpillars harvested by members of the local community and 8 host plants for the latter. In order to ensure the sustainability of this protein source, protection and preservation measures should be applied to conserve caterpillar species against exploitation and excessive deforestation.

Keywords: Edible caterpillars, Caterpillar host plants, Community forest, Nord Ubangi.

INTRODUCTION

Throughout the world and over the centuries, insects have been an important part of the human diet. In Europe, Asia, Australia and Africa, people feed on different stages of various insects (Malaisse, 2004; Paiko *et al.*, 2014). Estimates of the number of insect species consumed by humans vary, but worldwide, at least 1,400 species have been recorded in human food (FAO, 2010). Within these insects, Orthoptera (grasshoppers and locusts), Isoptera (termites) and Lepidoptera larvae (caterpillars) constitute the three major food groups (Malaisse *et al.*, 2003).

Among these groups, caterpillars are in second place, with a scientifically determined population of 396 species consumed (Malaisse *et al.*, 2017); they are a healthy and nutritious food resource, rich in fats, proteins, vitamins, fibres and minerals; populations seek them for their protein content as a substitute for meat and fish (Womeni *et al.*, 2009; FAO, 2014a; Foua *et al.*, 2015; Yapo *et al.*, 2017; Tao & Li, 2018). They are very common in forests, easy to collect and are an abundant and popular food source in Central Africa (Vantomme *et al.*, 2004).

A number of researchers have described the chemical composition and nutritional values of various caterpillars as presented in the table below.

Table 1. Previous studies conducted on different species of carterpillars.

Studies	Studied species	Proximate composition
Anvo <i>et al.</i> (2016)	<i>Cirina butyrospermi</i> Vuillet	Proteins, Minerals, Essential and non-essential amino-acids
Yapo <i>et al.</i> (2017)	<i>Cirina butyrospermi</i> Vuillet	Proteins, Minerals, Essential and non-essential amino-acids
Foua <i>et al.</i> (2015)	<i>Imbrasia oyemensis</i> Rougeot	Proteins, carbohydrates, minerals, essential amino acids, fats
Kalonda <i>et al.</i> (2015)	Several edible species	Immuno-modulators substances and secondary metabolites
Okangola <i>et al.</i> (2016)	Several edible species	Proteins, fats, carbohydrates and minerals
Muvundja <i>et al.</i> (2013)	<i>Bunaeopsis aurantiaca</i> Rothschild	Proteins, fats, carbohydrates and minerals
Akpossan <i>et al.</i> (2015)	<i>Imbrasia oyemensis</i> Rougeot	Minerals, saturated and unsaturated fatty acids.

In the Democratic Republic of the Congo (DRC), caterpillars account for 40% of total animal protein consumption (Latham, 2003). In Kinshasa, for example, more than 70% of the population consumes caterpillars along the year. The main supply provinces of the capital are the Grand Equateur (64%) and Bandundu (24%). Four main caterpillar species are consumed namely: *Cirina forda*, *Imbrasia epimethea*, *Imbrasia erthi* and *Imbrasia oyemensis* (Malaisse *et al.*, 2003; Womeni *et al.*, 2009; Lisingo *et al.*, 2010; FAO, 2014b). In the province of Nord-Ubangi, caterpillar collection is still an informal activity. This harvest is intended for self-consumption or sale as such or after processing (drying) and they generate income for local populations. As such, caterpillars (non-timber forest product) are an effective means of fighting against poverty (Ngbolua *et al.*, 2014a). Despite the large number of studies carried out to date in DRC, there is very little information on the exploitation and markets of caterpillars in Equateur province and precisely in Nord-Ubangi. Caterpillars have never been the subject of scientific studies in this part of the country. However, the development of these natural resources would make it possible to ensure food security in this region facing poverty.

This survey was carried out on the assumption that the forest of Gbado-Lite city would be overflowing with a diversity of caterpillars and host plants that serve as their food, the purpose of the study is to inventory and identify different species of edible caterpillars in and around Gbado-Lite and their host plants. In addition, the study can also identify other local utilities of these caterpillar trees and assess their impact on the availability of the attached caterpillars and propose measures to preserve these trees against their misuse for the conservation of the identified caterpillar species.

MATERIALS AND METHODS

Study area

This study was carried out in the Kota-koli community forest, located at 90 km far from Gbado-lite city, in Nord Ubangi province in DRC (Fig. 1) between October 2016 and May 2017.

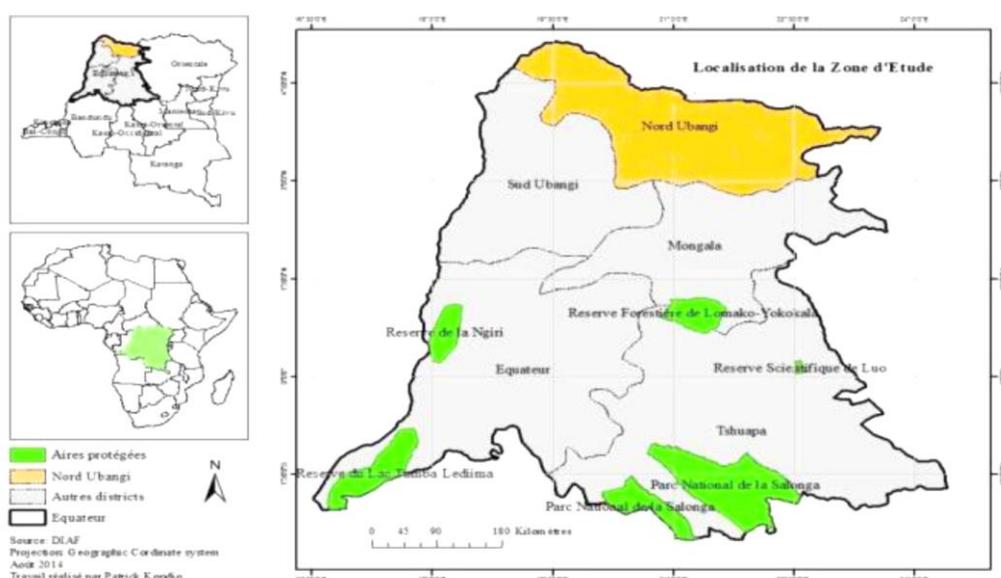


Figure 1. Geographical location of Nord Ubangi. [Source: Ngbolua *et al.*, 2015]

The City of Kota-Koli is located at $2^{\circ} 47' N$ and $24^{\circ} 47' E$ and is perched at 410 m average altitude. It is located in the centre of a forest environment and is part of the large equatorial forest that extends from Maniko-Kota Koli-Yakoma-Abumombazi. Its soil is of the ferralitic type established on basic rocks with some schist-limestone outcrops in some areas. The only gemstone found there is the diamond (Tuka, 2007).

This city is crossed by some rivers. For example, south of Kota-Koli is the Paki spring which, through the Mbitene stream, flows into the Ubangi River. There is also the Zubu spring, which flows through Lobe into the Mongala River just in Bobwato. There are still rivers in the south of Kota-Koli village, such as Ndekere, Likila, Lenge, which have met in the south to flow into the Ubangi River (Koyagiolo, 2011). The forest plant species commonly found in the Kota-Koli forest are: *Khaya* spp., *Ceiba pentandra* (L.) Gaertn., *Milicia excelsa* (Welw.) C.C. Berg, *Diopyros* spp., etc. In addition to the commercial exploitation of its species, these forests are also the domain of various animals due to the long history of biocenosis and greater diversification of ecological niches. It is about: Gazelle, Buffalo, Monkey, Leopard, Boa, Antelope, Wild Boar, Civet and even the famous Okapi (Ngbolua *et al.*, 2014b). It should be noted that, around 2014, a German commission called PARAP initiated a team of experts to explore the Kota-Koli forest with a view to erecting a reserve.

The main activities of the populations of Kota-Koli village, apart from artisanal diamond mining, are: agriculture and livestock farming as well as socio-professional activities (Anonymous, 2005). The agriculture practiced by the population of this community is of the food type with the main speculations: Maize, Cassava, groundnuts, Bananas and gourds. It is itinerant slash-and-burn agriculture in all cases and practiced in the Mbui forest. Most of these agricultural productions do not have a very good yield because of the degrading state of the Agricultural Access Roads and the practice of increasingly rudimentary farming methods.

Investigation

In this survey, we used Mobouna *et al.* (2016) protocol coupled with a faunistic and floristic inventory according to DIAF (2015); it was conducted respectively at local markets, among caterpillar suppliers, and in the community forest of Kota-Koli village, among artisanal wood miners in the forest of Gbado-Lite and its surroundings.

The first method consisted in conducting preliminary and actual socio-economic surveys in the markets of Kota-Koli village. The wildlife inventory examined edible caterpillars by identifying species divided into families. The floristic inventory focused on the host plants of edible caterpillars following specific key identification.

The data collection was made possible through the use of documentary and interview techniques. The documentary technique has facilitated the collection of data in scientific books and articles as a key to systematic determination. While the structured interview technique with the survey questionnaire as a tool containing some questions to collect the necessary information from caterpillar suppliers and consumers in the selected local markets was used.

RESULTS AND DISCUSSION

A total of 10 caterpillar species have been recorded from 32 caterpillar suppliers, both male and female, aged around 45 years and have attended at least primary school. Seven of these ten caterpillar species are correctly identified as follows: *Elaphrodes lactea* Gaede, *Anaphe panda* Boisduval, *Pseudanthera discrepans* Butler, *Imbrasia epimethea* Drury, *Imbrasia oyemensis* Rougeot, *Imbrasia truncata* Aurivilliu and *Antheua insignata* Gaede. The remaining three are not well identified by their scientific names. They are known locally as Ngola, Nzangana and Gborombe in the Ngbandi language. Figure 2 shows the photographed images of some caterpillars inventoried and identified in the local markets of Kota-Koli village.

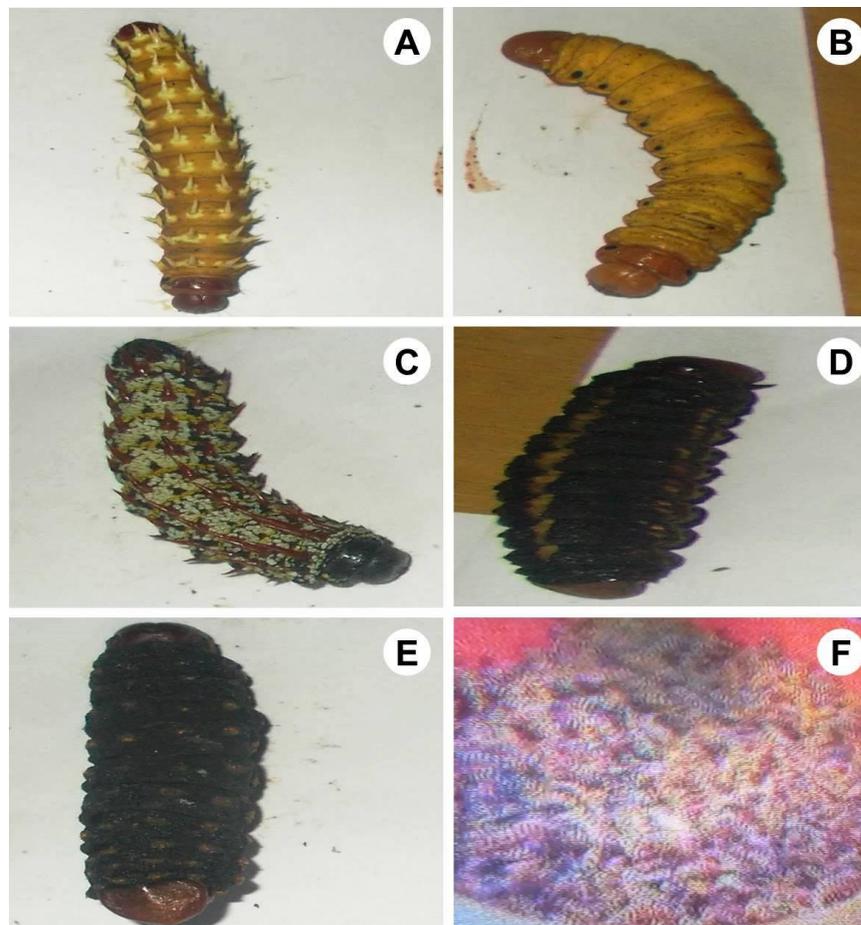


Figure 2. Some carterpillar species of community forest of Moanda: **A**, Non-identified; **B**, *Pseudanthera discrepans* Butler; **C**, *Imbrasia oyemensis* Rougeot; **D**, *Elaphrodes lactea* Gaede; **E**, *Imbrasia truncata* Aurivillius; **F**, *Anaphe panda* Boisduval.

Table 2 lists the caterpillars and their host trees. The list of caterpillars includes scientific and local names and the harvest period, while the list of host trees includes scientific and local names and their local utility.

Table 2. List of caterpillars and host trees listed and identified in Kota-Koli city.

Caterpillars				Host Trees		
Scientific names	Family	Local Name	Period	Scientific Name	Local Name	Local use
<i>Elaphrodes lactea</i> Gaede	Notodontidae	Poso (Ngbandi)	Jun.-Jul.	<i>Piptadeniastrum africanum</i> (Hook.f.) Brenen	Kpokolo (Ngbandi)	Energy wood
<i>Anaphe panda</i> Boisduval	Notodontidae	Gbado-Gbado (lingala); Putu (Ngbandi)	Aug.-Sep.	<i>Triplochiton scleroxylon</i> K.	Gbau (Ngbandi)	Timber
<i>Pseudanthera discrepans</i> Butler	Attacidae	Mbengeli ou Yambalo (Ngbandi)	Jul.-Aug.	<i>Erythrophloeum suaveolens</i> (Guill. et. Pen) Bren.	Ngbanda (Ngbandi)	Firewood
<i>Imbrasia epimethea</i> Drury	Attacidae	Gegere (Ngbandi)	Jul.-Aug.	<i>Ricinodendron heudelotii</i> (Baill.) Pierre ex Heckel	Gbukulu	Manufacturing of pirogue
<i>Imbrasia oyemensis</i> Rougeot	Attacidae	Mboyoy (Ngbandi)	Jul.-Aug.	<i>Entandrophragma cylindricum</i> Sprague	Sapelli	Timber
<i>Imbrasia truncata</i> Aurivilliu	Attacidae	Mbanga (Ngbandi)	Jul.-Aug.	<i>Petersianthus macrocarpus</i> (P.Beauv) Iiben	Watene (Ngbandi)	Timber
<i>Antheua insignata</i> Gaede	Notodontidae	Mbigi (Ngbandi)	Jun.-Jul.	<i>Macaranga monadra</i> Mull.	Mbamba	Firewood
-	-	Ngola (Ngbandi)	Aug.-Sep.	-	Ngola-nyama	Firewood
-	-	Nzangana (Ngbandi)	Jul.-Aug.	<i>Entandrophragma cylindricum</i> Sprague	Mboyoy	Timber
-	-	Gborombe (Ngbandi)	Aug.-Sep.	-	Tota ou Wako (Ngbandi)	Firewood

This study identified 10 edible caterpillar species and 8 host plants (Table 2). These caterpillars belong to two families of which: Attacidae and Notodontidae, among which Attacidae dominate with 4 species, while Notodontidae have 3 species; three of these 10 species could not be identified. Our results are lower than those found by Lisingo *et al.* (2010), who identified 15 edible caterpillar species and 23 host plants in Kisangani and Tshopo districts; moreover, in this study, we did not inventory the species belonging to the saturniidae family. Moreover, Okangola *et al.* (2016) identified 12 caterpillar species in and around Kisangani City while Latham (2015) has listed 35 species of edible caterpillars and their food plants in the province of Kongo Central (the former Bas-Congo province). Balinga (2003) found nine species in the Cameroonian forest zone while N'Gasse (2003) recorded 24 species in the Central African Republic forest region, including 12 species in the Ngotto massif. Malaisse (1997) identified 38 different caterpillar species when crossing the DRC, Zambia and Zimbabwe. It should be noted that there are significant differences in caterpillar diet from one region to another (Lisingo *et al.*, 2010).

To our knowledge, this is the first time that such a study has been carried out in Nord-Ubangi province. Another study focused instead on other non-timber forest products (NTFPs), including *Cola acuminata* (P. Beauv.) Schott & Endl and *Piper guineense* Schumach. & Thonn (Ngbolua *et al.*, 2014a), not a single one of them concerned caterpillars in this part of the country. However, these products are useful in food security. Indeed, the consumption and trade of NTFPs can contribute to the population's food security and is an effective means of fighting poverty (Debroux & Dethier, 1993; Ngbolua *et al.*, 2014a).

Referring always to the above table, we note that the host plants of the caterpillars are mainly used by the population for timber, firewood, energy wood and for the manufacture of canoes.

The harvest period is from June to September. It corresponds to the period of heavy rains that affect the remarkably dense foliage of trees. However, the species *Anaphe panda* Boisduval, locally known as Gbado-gbado or putu, is harvested in large quantities over a long period of time compared to the rest of the caterpillars.

CONCLUSION

This study was initiated to identify the caterpillar species harvested in the Kota-Koli forest and plants that support them. The findings showed that ten species of caterpillars are harvested by the local community and serve as a source of animal protein for the population's food. Of these 10 caterpillars inventoried, seven are correctly identified. The remaining three caterpillars could not be identified by their scientific names.

Given that the surrounding population of the study area often uses these forest species to meet several basic needs (energy, construction), protection and conservation measures should be recommended to prevent the exploitation and excessive deforestation of the forest directly affecting the caterpillar host trees. The Forest Administration of the Nord Ubangi Province must therefore work to ensure the integral preservation of the biodiversity of the forest massif in this part of the DRC.

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