SELECTION OF PLANTS CONSUMED BY CHIMPANZEES AND HUMANS IN AN AGROFORESTRY SYSTEM ON THE EASTERN PERIPHERY OF TAÏ NATIONAL PARK, SOUTHWESTERN CÔTE D'IVOIRE

Abstract

The main objective of this study, which took place in the eastern peripheral zone of the Taï National Park (TNP), was to identify the food plants consumed by chimpanzees and humans. The methodologyconsisted first of all in conducting a bibliographic research, then in conducting surveys among local populations and in carrying out pedestrian surveys in the plantations in the eastern peripheral zone of the TNP. At the end of the surveys, 13 plants species were listed as beingconsumed by bothchimpanzees and humans. The main organs of these consumed plants are : fruits, leaves, stem pith. Of the 13 plant species, five (5) are domesticated in the plantations. While some of these plants are either left in the plantations by farmers for their food use, others have been introduced into the plantations at the instigation of the park manager in order to limit human-wildlife conflicts.

Key Words *:Chimpanzee, Human, Food Plants, Human-Wildlife Conflicts*

Introduction

The whole world is facing a worrying degradation and loss of biodiversity due to human activities (Norro, 2017; IUCN, 2019). One of the strategiesadoptedglobally in recent decades to mitigate biodiversity degradation is agroforestry (Torquebiau et al., 2002; FAO, 2008). Agroforestry is a land use system in which woody species are deliberately used on the same unit as agricultural plants, animals in a form of spatial arrangement or temporal sequence (Lundgren&Raintree, 1982; Alexandre, 2002). In Côte d'Ivoire, the natural spaces where animals still live are a few "green islands" in the middle of farms, thus causingdiscomfort on bothsides. Indeed, completelycleared areas containing only agricultural plants still do not have the desiredyield and when they are close to natural habitats, animals come to help themselves. In the southwest of the country, the main remaining natural area is the Taï National Park (PNT). It stillcontainsgreatwealth of both flora and fauna. However, it is subject to a lot of pressure from populations, especially on its eastern periphery where there are large farms. The chimpanzee, a species classified as "Critically Endangered", still present in large numbers in this park, often comes into conflict with humans, bothinside the park

and in the plantations. Indeed, the chimpanzee is a species that has many food resources in common with humans (IUCN, 2020). This spatial and food proximityrequires cohabitation that should be analyzed in the interest of both species. Indeed, to understand our feeding behavior, we must go back wellbeyond the period during which Australopithecus and the first species of the genus Homo differentiated. The search for food, for a chimpanzee, necessarilydepends on the ecosystem, where one can freely use the available products distributedboth in space and time according to the periodicity of seasonalclimaticphenomena (IUCN, 2020). Even if entering the park without authorization is illegal, people continue to go there to gather food plants for their needs, undermining the integrity of this world heritage. Also, chimpanzeesmakedevastating incursions into the fields on the periphery of the park. To mitigate these conflicts and find solutions that benefit humans and animals, an agroforestryproject with food plants has been initiated on the eastern periphery of the park. To contribute to this initiative, it would be useful to focus on food plants consumed by both humans and chimpanzees. The overall objective of this study is to contribute to sustainable wildlife management by mitigating human-wildlife conflict. Specifically, it involves: (i) identifying food plants consumed by chimpanzees; (ii) identifying food plants consumed by bothchimpanzees and humans.

Methodology

Study site

Taï National Park is located in the southwest of Côte d'Ivoire, between 5°10' and 6°20' north latitude and between 4°20' and 6°20' west longitude. It is located in the Cavally and Nawa region, near the border with Liberia. It is approximately 20 km east of the town of Taï (Esser, 1994). The park covers a total area of approximately 536,000 ha (IUCN, 2008) (**Figure 1**).

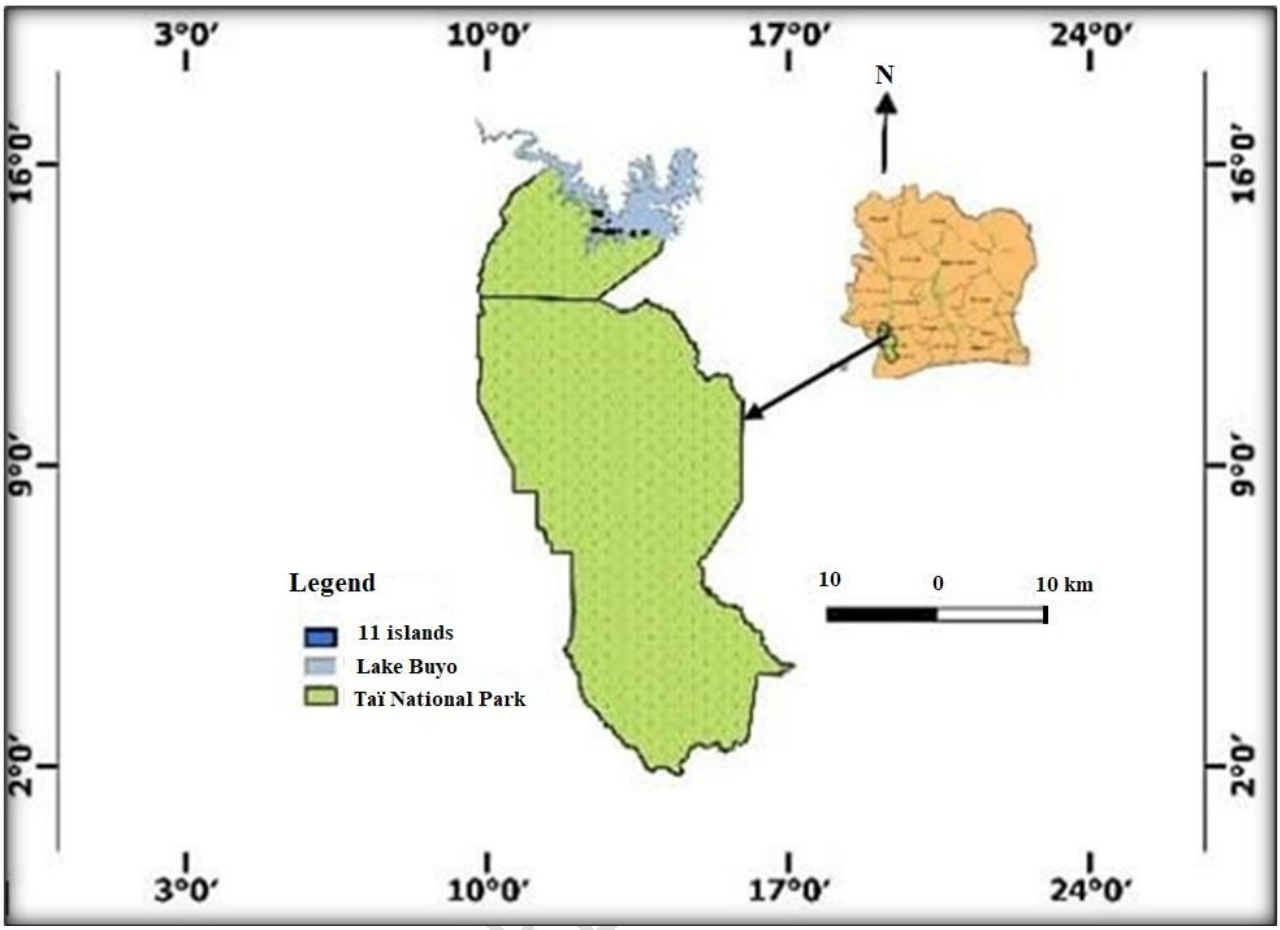

Figure 1 : Location of Taï National Park

Data collection methods

Three methods were combined to carry out this work in order to maximize the reliability of the results, (i) bibliographic research (ii) surveys of local populations (iii) pedestrian prospecting. The criteria for selecting villages for data collection were based on their proximity to the park. Thus, the data were collected in the villages of Tiétaly located in the Buyosub-prefecture and Sarakagui in the Soubré sub-prefecture (**Figure 2**).

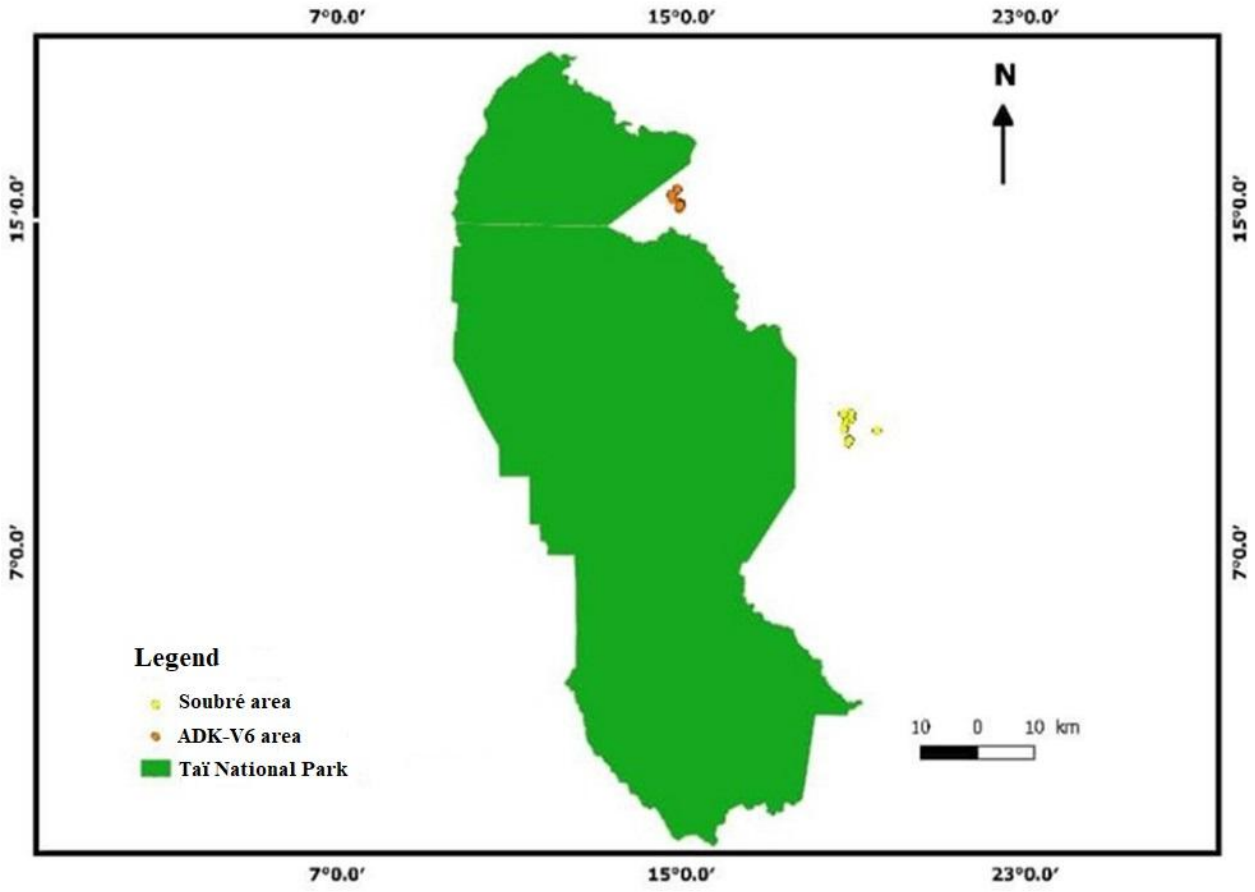

Figure 2 : Soubré (Sarakagui) and ADK-V6 (Tietaly) data collection areas

Bibliographic research

Research on the diet of chimpanzees in Taï National Park (PNT) was consulted in order to produce a list of plants regularly consumed by them (Gone Bi, 2007; N'guessan, 2012).

Survey of local populations

The objective of this survey was to obtain from the population the names of plants consumed by chimpanzees and humans. To achieve this, people from two villages located on the periphery of the PNT were interviewed. During this survey, individuals who had stayed in the area for a long time, people who had their plantation on the periphery of the park, and OIPR guides involved in ecological monitoring programs were interviewed. A total of 20 people were individuallyinterviewed. The surveys were conducted with the prior agreement of the village chiefs.

Foot prospecting

The objective of the pedestrian surveys on the periphery of the PNT was to confirm the presence in the plantations of the plants reported during the surveys and present on the referencelist while marking their geographical coordinates. The pedestrian surveys were carried out using the reconnaissance walking technique. This technique consists of making observations while moving slowly and silently at a speed of approximately 0.5 to 1 km/h, using areas of least resistance in the plantations (animal tracks, human tracks, clear undergrowth, ridgelines). Whenever an obstacle is encountered, a deviation not exceeding 40° may be authorized (Tutin, 1991). When a plant present on the list is identified, the name and geographical coordinates are marked and a photograph is taken.

Data analysis

Two software programs (PAST 3.10 and QGIS 3.10) were used for data analysis. PAST 3.10 was used to perform statistical tests on frequency differences and to calculate numerical abundance. QGIS 3.10 was used to create maps of the study area and the distribution of plants consumed by chimpanzees and humans around Taï National Park.

Plant identification was based on the illustrated guides to the flora of the TNP (Aubreville, 1959; TNP Management Unit, 2000) and the list of plants regularly consumed by chimpanzees in the TNP (N'guessan, 2012). The proportion of consumption of a given plant organ (P) is the ratio of the number of species whose organ is consumed to the total number of species consumed. It is determined according to the following equation: $P = (ni /N) \times 100$, with P: Percentage of consumption of an organ, ni: number of plant species whose organ i is consumed and N: the total number of species whose organs are consumed.

Results

Plants regularly consumed by chimpanzees in Taï National Park

The pedestrian surveys made it possible to identify 45 plant species belonging to 27 families. All these plant species are regularly consumed by chimpanzees in Taï National Park. The different parts consumed by chimpanzees at the level of these plants are the fruits (71.12%; N = 32), the leaves (15.55%; N = 7) and the pith of the

stems (13.33%; N = 6). At the level of the Arecaceae and Marantaceae Families, it is the pith of the stems which are more consumed (Kruskall-Wallis test, p-value = 0.02 < 0.05; X2 = 11.58) (**Table I**).

Table I: Plants regularly consumed by chimpanzees at TNP

FAMILY	**SCIENTIFIC NAME**	**PART CONSUMED**		
		Fruit	Leaf	Bone marrow
Apocynaceae	*Landolphia hirsuta*	X		
Arecaceae	*Ancistrophyllumsecundiflorum*			X
Arecaceae	*Chrysophyllumtaiense*	X		
Arecaceae	*Elaiesguineensis*			X
Arecaceae	*Eremorpathamacrocarpa*			X
Anacardiaceae	*Tricoscyphaarborea*	X		
Burseracea	*Dacryodesklaineana*	X		
Caesalpiniaceae	*Afzeliabella*		X	
Caesalpiniaceae	*Detariumsenegalense*	X		
Caesalpiniaceae	*Dialium aubrevillei*	X		
Chailletiaceae	*Dichapetalum pallidum*		X	
Chrysobalanaceae	*Magnistipulabutayei*	X		
Dioscoreaceae	*Dioscoreamultiflora*		X	
Euphorbiaceae	*Kaeyodendronbrideloides*	X		
Euphorbiaceae	*Manniophytonfulvum*		X	
Flacourtiaceae	*Scotelliaklaineana*	X		
Fabaceae	*Platysepalumhirsutum*	X		
humiriaceae	*Sacoglottisgabonensis*	X		
Irvingiaceae	*Klainedoxagabonensis*	X		
Irvingiaceae	*Irvingiagrandifolia*	X		
Lauraceae	*Beilschmiediamanni*	X		
Marantaceae	*Halopegiaazurea*			X
Marantaceae	*Hypselodelphysviolacea*			X
Marantaceae	*Sarcophrynium sp*			X
Melastomataceae	*Memecylon sp*	X		

Melastomataceae	*Tristemmacoronatum*		X	
Mimosaceae	*Calpocalyx sp*	X		
Mimosaceae	*Parkia bicolor*	X		
Moraceae	*Antiariswelwischii*	X		
Moraceae	*Ficus sp*	X		
Moraceae	*Musangacecropiodes*		X	
Myristicaceae	*Treculia africana*	X		
Myristicaceae	*Pseudospondiasmicrocarpa*	X		
Myristicaceae	*Pycnanthusangolensis*	X		
Myristicaceae	*Uapaca sp*	X		
Octoknemataceae	*Coula edulis*	X		
Olacaceae	*Strombosiapustulata*	X		
pandaceae	*Panda oleosa*	X		
Rubiaceae	*Nauclea xanthoxylon*	X		
Rosaceae	*Parinariexcelsa*	X		
Sapotaceae	*Pouteriaaningeri*	X		
Sterculiaceae	*Sterculiaoblonga*	X		
Tiliaceae	*Dubosciaviridiflora*	X		
Tiliaceae	*Glyphaeabrevis*		X	
Tiliaceae	*Grewia bicolor*	X		
	Total	**N=32**	**N= 7**	**N = 6**

Plants consumed by bothchimpanzees and humans according to surveys around the TNP

At the end of the surveys, it was noted that 13 of the 45 plants consumed by chimpanzees are also consumed by humans, or 28.8%. These are plants whose organsconsumed are mainly fruits (92.3%), the palm tree whose fruits and pith (heart) are consumed and the yam whose tubers are consumed (Kruskall-Wallis test, p-value = 0.007 < 0.05; X2 = 11.47) (**Table II**).

Table II: Plants consumed by chimpanzees and humans according to the survey

SCIENTIFIC NAME	**ORGAN CONSUMED BY MEN**			
	Leaf	Fruit	Bone marrow	Stem
Bechimediamanni		X		
Calpocalyxaubrevillei		X		
Coula edulis		X		
Dialium aubrevillei		X		
Discorea sp		X		X
Elaeis guineensis	X	X	X	
Glypheabrevis	X			
Irvingiagaboneinsis		X		
Klainedoxagabonensis		X		
Landolphia hirusta		X		
Nucleadiderrichi		X		
Nucleaxanthoxylon		X		
Parkia bicolor		X		
Treculia africana		X		
Total	N=2	N=13	N=1	N=1

Plants consumed by chimpanzees and humans according to pedestrian surveys in plantations

Walking surveys in the plantations located in the peripheral zone of the Taï National Park made it possible to identify five (5) species of plants consumed by bothchimpanzees and humans. These are: Elaeisguineensis, Irvingiagaboneinsis, Dialium aubrevillei, Coula edulis and Parkia bicolor. Among these plants, two (02) are natural plants of the environment which were left in the plantations by the farmers. These are Elaeisguineensis and Parkia bicolor. On the other hand, the other three (3) were planted by the farmers in an agroforestry program initiated by the OIPR to contribute to the mitigation of human-wildlife conflicts. These plants are represented by Irvingiagaboneinsis, Dialium aubrevillei, and Coula edulis (**Figure 3**).

Irvingiagaboneinsi

Elaeisguineensis

Coula edulis

Parkiabicolor

Dialiumaubrevillei

Figure 3 : Plants eaten by bothchimpanzees and humans around the TNP

Discussion

The combination of the three methods made it possible to note that among the 45 plant species consumed by chimpanzees in Taï National Park, 13 are also consumed by humans in the eastern periphery of Taï National Park. Also, the plant

organsconsumedby chimpanzees and humans are almost identical. This area of dietaryoverlap between chimpanzees and humans could be justified by the geneticproximity between the two species (Boesch &Tomasellon, 1998; Edwards &Beerli, 2000). This proximity very often puts the two species in conflict in cohabitation areas such as the periphery of Taï National Park. Studies carried out on the typologies of human-wildlife conflicts have shown that one of the fundamentalreasonswhy wildlife comes into conflict with humans is the search for food resources by humans, since their home areas have been replaced by agricultural plantations (Gone Bi, 2007). An equitable presence of plants consumed by the two neighboring species in their respective living environments could mitigate these conflicts (Groves, 2001). In this sense, it was noted during the present study that among the 13 plants common to both species (Human and Chimpanzee), five (5) were identified as used in agroforestry. This relatively low number is certainlylinked to the apprehensions that farmers have regarding the presence of certain plants in plantations (Mollet et al., 2000). Indeed, the choice of cultivation of a given wild plant is often based on its food, commercial, medical utility and its impact on the leaves and the soil. This criterion for choosing a tree in agroforestry has been confirmed by someprevious studies (Isaac et al., 2007). According to these studies, following farmers' perceptions, certain species cultivated in agroforestry could be identified as being favorable to crops. This categoryexclusively includes forest species for food, medicine or timber (Mollet et al., 2000; Isaac et al., 2007; Dupraz&Liagré, 2008). However, some authors believe that the persistence of these large trees is linked to the fact that farmers are unable to cutthem down during agricultural clearing (Zapfack et al., 2002; Adou Yao et al., 2006). In any case, several studies have shown the importance of agroforestry compared to traditionalsystems which consisted of complete clearing when planting (Adou et al., 2011).

Conclusion

Bibliographic research, surveys and walking surveys in the plantations used during this study made it possible to establish a list of plant species consumed by bothchimpanzees and humans on the periphery of the Taï National Park and to determine those cultivated in agroforestry in this area. Thus, 13 plant species were listed as beingconsumed by bothchimpanzees and humans on the periphery of this park. The main organs of these plants consumed by both these primate species are:

fruits, leaves, stem pith. Of these 13 plant species, only five (5) are cultivated in agroforestry.

Conflicts of interest

The authors declare that there is no conflict of interest for this article.

Authors' contribution

KOUAME ANTOINE N'GUESSAN initiated this project. KRAMOKO BAMBA and MASSANDJE MAMY DIABATE performed the data processing, statistical analysis, and manuscript writing. The other co-authors contributed to proofreading and improving the article.

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