

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

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

4 **Abstract**

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

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

17 **Introduction**

18 The whole world is facing a worrying degradation and loss of biodiversity due to
19 human activities (Norro, 2017; IUCN, 2019). One of the strategies adopted globally in
20 recent decades to mitigate biodiversity degradation is agroforestry (Torquebiau et al.,
21 2002; FAO, 2008). Agroforestry is a land use system in which woody species are
22 deliberately used on the same unit as agricultural plants, animals in a form of spatial
23 arrangement or temporal sequence (Lundgren & Raintree, 1982; Alexandre, 2002). In
24 Côte d'Ivoire, the natural spaces where animals still live are a few "green islands" in
25 the middle of farms, thus causing discomfort on both sides. Indeed, completely cleared
26 areas containing only agricultural plants still do not have the desired yield and when
27 they are close to natural habitats, animals come to help themselves. In the southwest
28 of the country, the main remaining natural area is the Taï National Park (PNT). It
29 still contains great wealth of both flora and fauna. However, it is subject to a lot of
30 pressure from populations, especially on its eastern periphery where there are large
31 farms. The chimpanzee, a species classified as "Critically Endangered", still present in
32 large numbers in this park, often comes into conflict with humans, both inside the park

33 and in the plantations. Indeed, the chimpanzee is a species that has many food
34 resources in common with humans (IUCN, 2020). This spatial and food
35 proximity requires cohabitation that should be analyzed in the interest of both species.
36 Indeed, to understand our feeding behavior, we must go back well beyond the period
37 during which *Australopithecus* and the first species of the genus *Homo* differentiated.
38 The search for food, for a chimpanzee, necessarily depends on the ecosystem, where
39 one can freely use the available products distributed both in space and time according
40 to the periodicity of seasonal climatic phenomena (IUCN, 2020). Even if entering the
41 park without authorization is illegal, people continue to go there to gather food plants
42 for their needs, undermining the integrity of this world heritage. Also,
43 chimpanzees make devastating incursions into the fields on the periphery of the park.
44 To mitigate these conflicts and find solutions that benefit humans and animals, an
45 agroforestry project with food plants has been initiated on the eastern periphery of the
46 park. To contribute to this initiative, it would be useful to focus on food plants
47 consumed by both humans and chimpanzees. The overall objective of this study is to
48 contribute to sustainable wildlife management by mitigating human-wildlife conflict.
49 Specifically, it involves: (i) identifying food plants consumed by chimpanzees; (ii)
50 identifying food plants consumed by both chimpanzees and humans.

51 Methodology

52 Study site

53 Taï National Park is located in the southwest of Côte d'Ivoire, between 5°10' and
54 6°20' north latitude and between 4°20' and 6°20' west longitude. It is located in the
55 Cavally and Nawa region, near the border with Liberia. It is approximately 20 km east
56 of the town of Taï (Esser, 1994). The park covers a total area of approximately
57 536,000 ha (IUCN, 2008) (Figure 1).

58

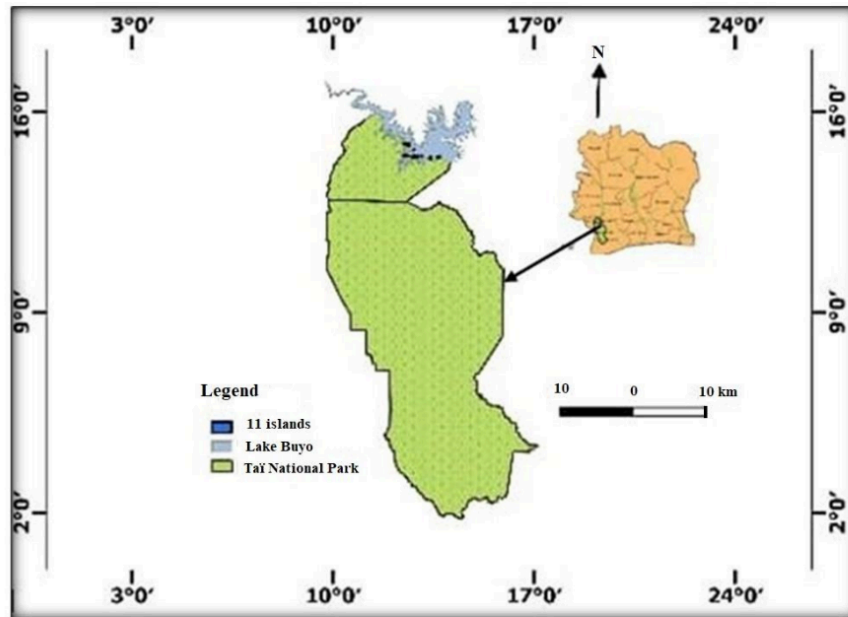
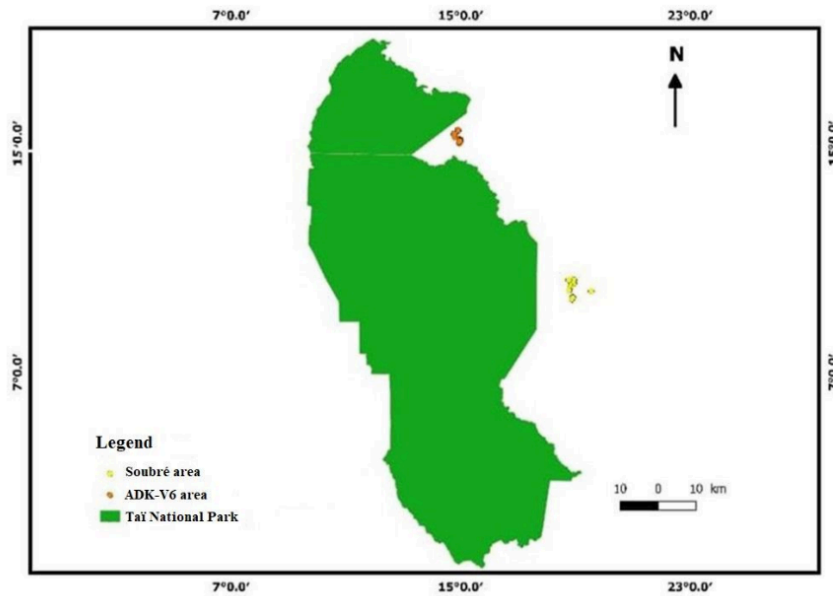


Figure 1 :Location of Taï National Park

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).



68

69 **Figure 2** :Soubré (Saragagui) and ADK-V6 (Tietaly) data collection areas

70 **Bibliographic research**

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

74 **Survey of local populations**

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

82

83 **Foot prospecting**

84 The objective of the pedestrian surveys on the periphery of the PNT was to confirm
85 the presence in the plantations of the plants reported during the surveys and present on
86 the referencelist while marking their geographical coordinates. The pedestrian surveys
87 were carried out using the reconnaissance walking technique. This technique consists
88 of making observations while moving slowly and silently at a speed of approximately
89 0.5 to 1 km/h, using areas of least resistance in the plantations (animal tracks, human
90 tracks, clear undergrowth, ridgelines). Whenever an obstacle is encountered, a
91 deviation not exceeding 40° may be authorized (Tutin, 1991). When a plant present on
92 the list is identified, the name and geographical coordinates are marked and a
93 photograph is taken.

94 **Data analysis**

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

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

108 **Results**

109 **Plants regularly consumed by chimpanzees in Taï National Park**

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

114 stems (13.33%; N = 6). At the level of the Arecaceae and Marantaceae Families, it is
 115 the pith of the stems which are more consumed (Kruskall-Wallis test, p-value = 0.02 <
 116 0.05; X² = 11.58) (**Table I**).

117 **Table I:** Plants regularly consumed by chimpanzees at TNP

FAMILY	SCIENTIFIC NAME	PART CONSUMED		
		Fruit	Leaf	Bone marrow
Apocynaceae	<i>Landolphia hirsuta</i>	X		
Arecaceae	<i>Ancistrophyllum secundiflorum</i>			X
Arecaceae	<i>Chrysophyllum taiense</i>	X		
Arecaceae	<i>Elaeagnus guineensis</i>			X
Arecaceae	<i>Eremophyllum macrocarpa</i>			X
Anacardiaceae	<i>Tricoscypha arborea</i>	X		
Burseraceae	<i>Dacryodes klaineana</i>	X		
Caesalpinaceae	<i>Azeliabellia</i>		X	
Caesalpinaceae	<i>Detarium senegalense</i>	X		
Caesalpinaceae	<i>Dialium aubrevillei</i>	X		
Chaillotiaceae	<i>Dichapetalum pallidum</i>		X	
Chrysobalanaceae	<i>Magnistipula butayi</i>	X		
Dioscoreaceae	<i>Dioscorea multiflora</i>		X	
Euphorbiaceae	<i>Kaeyodendron brideloides</i>	X		
Euphorbiaceae	<i>Manniophyton fulvum</i>		X	
Flacourtiaceae	<i>Scotellia klaineana</i>	X		
Fabaceae	<i>Platysepalum hirsutum</i>	X		
Humiriaceae	<i>Sacoglottis gabonensis</i>	X		
Irvingiaceae	<i>Klainedoxa gabonensis</i>	X		
Irvingiaceae	<i>Irvingia grandifolia</i>	X		
Lauraceae	<i>Beilschmiedia manni</i>	X		
Marantaceae	<i>Halopogon azurea</i>			X
Marantaceae	<i>Hypselodelphys violacea</i>			X
Marantaceae	<i>Sarcophrynium sp</i>			X
Melastomataceae	<i>Memecylon sp</i>	X		

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

118

119 **Plants consumed by both chimpanzees and humans according to surveys around**
120 **the TNP**

121 At the end of the surveys, it was noted that 13 of the 45 plants consumed by
122 chimpanzees are also consumed by humans, or 28.8%. These are plants whose
123 organs consumed are mainly fruits (92.3%), the palm tree whose fruits and pith (heart)
124 are consumed and the yam whose tubers are consumed (Kruskall-Wallis test, p-value
125 = 0.007 < 0.05; $\chi^2 = 11.47$) (**Table II**).

126

127

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

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

129

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

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



141

142 **Figure 3** : Plants eaten by both chimpanzees and humans around the TNP

143 Discussion

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

organs consumed by chimpanzees and humans are almost identical. This area of dietary overlap between chimpanzees and humans could be justified by the genetic proximity 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 fundamental reasons why 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 certainly linked 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 some previous 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 category exclusively 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 cut them 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 traditional systems 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 both chimpanzees 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 being consumed by both chimpanzees and humans on the periphery of this park. The main organs of these plants consumed by both these primate species are:

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

182 **Conflicts of interest**

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

184 **Authors' contribution**

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

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