

Local People's Knowledge, Perceptions and Attitudes towards Chimpanzee Habitat Preferences around Douala-Edéa National Park, Cameroon

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Abstract

Local people-wildlife interactions and local knowledge are central to the effective conservation of endangered species and their habitats preferences. In Cameroon, the Central chimpanzee (*Pan troglodytes troglodytes*) is classified as endangered and persists in fragmented forest landscapes including the Douala-Edéa National Park (DENP), where growing human needs have exerted immense pressure on their natural habitats resulting to habitat loss and land-use changes that threaten their survival. However, there is limited empirical information on how local people living around the park perceive chimpanzee habitat preferences, understand ecological relationships, and how their knowledge and attitudes influence support for conservation. This study assessed local people's knowledge, perceptions, and attitudes toward chimpanzee habitat preferences in villages adjacent to the DENP. Data were collected through structured questionnaires, key informant interviews, and focus group discussions involving 251 respondents across twelve villages focusing on respondents' awareness of chimpanzee habitat characteristics, perceived factors driving habitat selection and attitudes toward chimpanzees and habitat protection. Data analysis were done using Microsoft Excel 2013 and R software version 4.1.0. Results indicate that 98.8% of local people possess substantial knowledge of chimpanzee habitat preferences, identifying dense forests (86.8%) as primary habitat preference. Seasonal movements toward farmland during fruiting periods were reported by 61.3% of respondents. Perceptions of chimpanzees were influenced by cultural beliefs, human-wildlife interactions, and land-use changes. Majority of respondents 88% expressed positive attitudes

toward conservation of chimpanzees. Despite conflicts, 69% of respondents indicated willingness to support conservation measures if livelihoods were safeguarded. The study highlights the value of integrating local people's knowledge into conservation planning and the need for community-based strategies to mitigate human-chimpanzee conflict, thereby promoting coexistence and sustainable protection of chimpanzee habitats.

Keywords

Chimpanzee, Conservation, Douala-Edéa National Park, Human-Wildlife Conflict, Local Ecological Knowledge

1. Introduction

The conservation of biodiversity continues to be of global concern since the signing of the United Nations Convention on Biological Diversity in 1992 in Rio [1]. Indeed, environmental issues have taken on a global dimension, varying from one to another [2]. These issues country stem from several factors of anthropogenic or natural origin, one of which is the overexploitation of wildlife [3]. This includes tropical forest species particularly chimpanzees threatened with extinction [4]. This is due to multiple pressures on their habitats and populations [5], resulting from illegal trade as pets, for traditional medicine, rituals, and local consumption [6]. The situation is particularly alarming despite the fact that they are classified as globally endangered on the International Union for Conservation of Nature (IUCN) Red List [7], the loss of fertile soils due to overexploitation and the scarcity or unavailability of land near villages have driven people closer to protected areas, reducing the living space of chimpanzees and fragmenting their habitat preferences [8], which refer to the behavioural and ecological flexibility by which chimpanzees selectively chooses, occupies, and utilizes specific environmental patches or vegetation types over others available within its broader geographical rang. Their habitat preferences are driven by the availability of food resources (particularly fruiting trees), sleeping sites, and adequate water and shelter [8].

Africa is particularly affected by the ongoing decline of chimpanzee habitat preferences due to environmental changes [9]. It is estimated that chimpanzees are rarely observed in areas with high hunting pressure [10] [11]. Over the last century, conservation policies have primarily focused on creating protected areas, often at the expense of indigenous peoples' rights, leading to their expulsion from their lands and generating long-lasting social conflicts [12]. In response, the IUCN has adopted a new conservation model that integrates local communities and recognizes their rights in management processes [13] [14]. Conservation efforts in protected areas are often compromised when local populations living nearby feel they do not benefit from preservation efforts [15]. The success of conservation initiatives largely depends on local attitudes (refers to as the evaluative judgments—positive, negative, or neutral—that individuals hold toward conservation

issues, species, or habitats. It integrates cognitive beliefs, emotional responses, and behavioral intentions, and is a key predictor of pro-environmental behavior), as local communities may exploit forests [16]. Sustainable conservation of natural resources is more effective when local populations are involved, and local ecological knowledge (that is, knowledge refer to the factual awareness or information individuals or communities possess about ecological systems, often derived from direct experience, cultural traditions, or scientific learning and represents cumulative ecological understanding passed down through generations) is integrated into conservation plans and actions [17]-[19].

Douala-Edéa National Park (DENP) is a large protected area in Cameroon's Littoral Region, spanning coastal lowland rainforest, mangroves and wetlands [20]. It includes core terrestrial forest and mangrove forest systems that form important habitat for many species, including the Central chimpanzee [21] [22]. The park's chimpanzee populations are small, and ongoing camera trap research confirms they occur and reproduce in parts of the landscape, indicating actual habitat preference rather than only indirect sign evidence [23]. Human pressures such as poaching, illegal logging, fishing, and mangrove exploitation continue to degrade habitat which likely influences where chimpanzees prefer to exploit within the park [24]-[27]. While specific peer-reviewed research on local people's knowledge regarding chimpanzee habitat preferences around Douala-Edéa is limited in published literature, insights from Cameroon and neighbouring areas provide useful parallels. For instance, in studies from other parts of Cameroon, most local respondents recognize chimpanzees and have knowledge about their presence and status [28] [29]. This includes awareness of chimpanzee ecology, occurrence patterns, and threats like hunting and habitat loss and traditional knowledge [30]-[32]. Respondents reported chimpanzees as decreasing in number primarily due to hunting and habitat loss, which are significant drivers of distribution and habitat preferences because chimpanzees tend to avoid heavily disturbed areas [33]. Local knowledge of habitat use often reflects observed behaviour as chimpanzees are seen more often in forest or dense vegetation and less near open areas or human-dominated land [34]. Although desk research specific to Douala-Edéa's local peoples' views on habitat preferences is scarce, these patterns often translate across chimpanzee range areas in Cameroon, as the species generally prefers dense forests and areas with rich canopy cover which are likely associated with food resources, shelter and nesting sites [34]. Open or heavily disturbed sites, chimpanzees avoid them due to hunting risk and lack of resources.

In other Cameroonian study areas, most locals expressed positive attitudes toward chimpanzee conservation, often tied to traditional beliefs, awareness of protective laws, or cultural value placed on wildlife [35]. Taboos and cultural narratives can influence positive perceptions (which is the cognitive and affective lens through which individuals interpret environmental realities, assign meaning to ecological phenomena, and evaluate conservation initiatives. It shapes how communities understand chimpanzee habitat preferences, conservation outcomes,

and human-wildlife interactions [36]) of chimpanzees, for example, viewing them as culturally significant or believing laws protect them [32]. Conversely, attitudes may be negatively affected where wildlife is seen as a competition for crops or a source of income (e.g., bushmeat), especially where economic incentives favor hunting [37]. Education levels, age, and local benefits from conservation (e.g., tourism or community support programs) influence how people view chimpanzee conservation efforts [38]. Despite the endangered status of the chimpanzee and its continued presence in and around Douala-Edéa National Park, local ecological information about this species' habitat and how nearby communities perceive, understand, and respond to chimpanzee habitat use remains poorly documented. Chimpanzees in Cameroon are known to be threatened by habitat degradation, illegal hunting, and land-use change, and these threats are often closely linked to human activities and attitudes [39]. However, the ways in which local communities around DENP understand where chimpanzees prefer to live either in dense forests and human-modified landscapes and how these understandings influence their perceptions and attitudes toward habitat conservation are not well understood. Equally, local ecological knowledge and attitudes toward great apes can greatly influence conservation outcomes [40], local people often hold varied knowledge about chimpanzee biology and behavior. Different perceptions are shaped by cultural beliefs and experiences, and mixed attitudes are influenced by economic incentives and conflicts with wildlife [28]. For example, in Mpem-Djim National Park, a high proportion of residents reported good knowledge of chimpanzees, taboos related to the species, awareness of protective laws, and generally positive views toward conservation, but attitudes varied with demographic factors like age and education [41].

Given this context, there is a critical gap in understanding how people living in close proximity to DENP conceptualize chimpanzee habitat preferences, such as preferences for dense forest cover versus edge or degraded habitats and how these perceptions influence their attitudes toward chimpanzee conservation and habitat protection. Without such insight, conservation planning and community-based interventions risk failing to align with local perspectives, potentially limiting effectiveness in protecting threatened chimpanzee populations and their habitats. Thus, this study seeks to assess local people's knowledge of chimpanzee habitat preferences, explore their perceptions and attitudes toward chimpanzees and habitat conservation, and identify sociocultural and demographic factors that shape these human-wildlife relationships around Douala-Edéa National Park.

2. Materials and Methods

2.1. Presentation of the Study Area

The Douala-Edéa National Park, formerly known as the Douala-Edéa Wildlife Reserve, is a protected area in Cameroon. It is located in the Littoral region, within the Sanaga Maritime department. Covering an area of approximately 2630 km², it stretches along the Atlantic coast south of Douala for about 35 km to the Dipomé

River [42]. The Douala-Edéa National Park is geographically located at $3^{\circ}30'00''\text{N}$, $9^{\circ}49'60''\text{E}$. Tissongo Lake, a lagoon connected to the southern bank of the Sanaga River by a five-kilometer tidal channel, is included in the reserve. This area of state public land, designated for wildlife conservation, encompasses the localities of Mouanko, Edéa, Dizangué, and the Manoka Islands. The park is bordered to the north by the southern suburbs of Douala, to the south by Kribi, and to the west by the Atlantic Ocean [43], as shown in **Figure 1**.

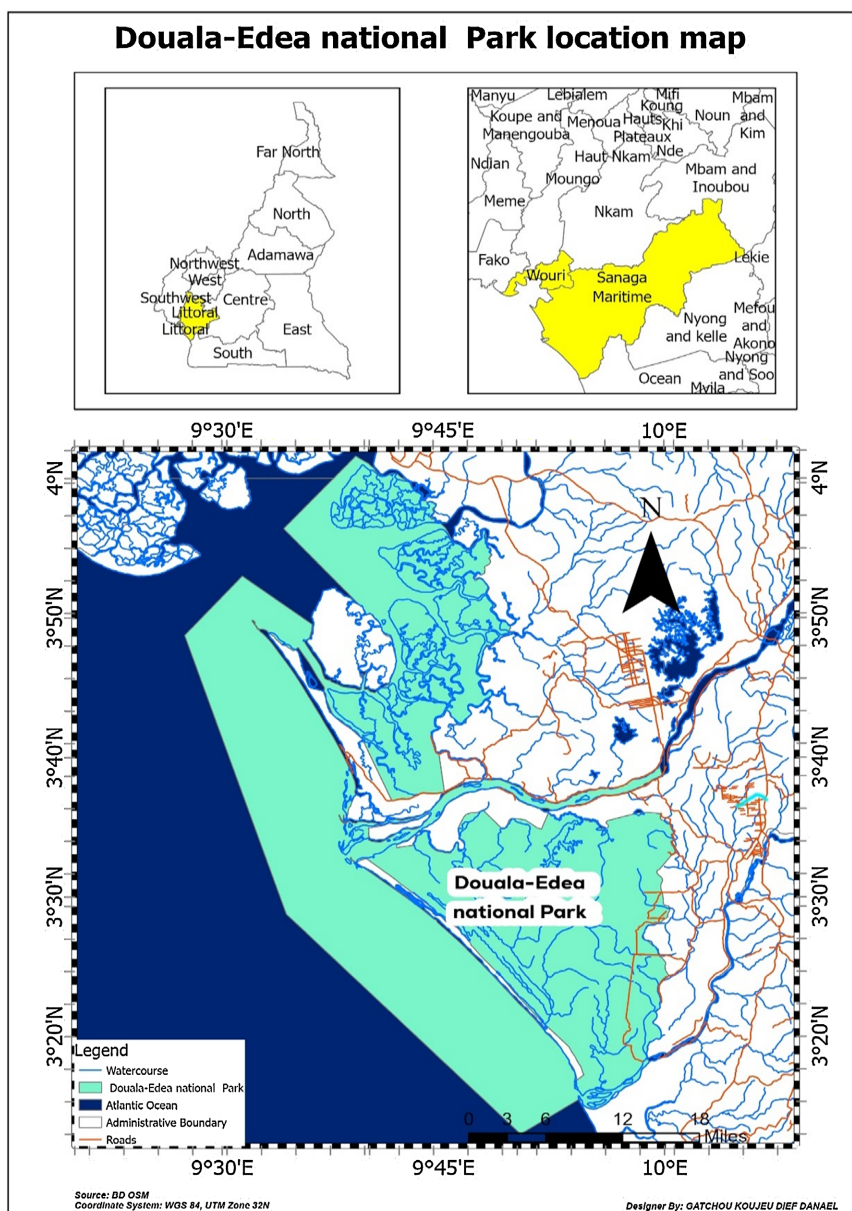


Figure 1. Location map of Douala-Edéa National Park.

2.2. Data Collection

Data collection for these surveys were conducted between the months of March to June 2024, corresponding to the period of intense human activities in the study

areas. Prior to selecting the technique to assess local people's knowledge, perceptions, and attitudes toward chimpanzee habitat preferences in villages adjacent to Douala-Edéa National Park, a preliminary survey was carried out where key informant interviews with village elders, hunters and the conservation staffs of the Douala-Edéa National Park after ethical approval was obtained from local authorities, and informed consent was secured from all participants. During this period, questionnaires were pre-tested in Mouanko and Ekoth villages and refined for clarity and focus group discussions with those engaged in farming, fishing, or forest-related activities to validate and enrich quantitative data.

After the preliminary survey, twelve (12) villages surrounding the Douala-Edéa National Park (Mouanko, Lobethal, Nbang, Pongo Songo, Okokong, Mariem-berg, Ongue, Ekoth, Abee, Ndongbiang, Yambong, Elocam) were selected based on characteristics they share, such as proximity to the park, dependence on natural resources from the park, and activities carried out around the park. Equally, preliminary studies help to develop questionnaire following the recommendations of [44] [45]. It included open-ended, binary, and multiple-choice questions, developed and refined with respect to the study. The questionnaire consisted of major sections, including: demographics and socioeconomic activities which described respondents' criteria such as gender, age, education level, ethnicity, economic activity, time spent in the community, and the distance of the village from the park. Knowledge about chimpanzee's abundance, distribution, habitat preference, behaviour across seasons, and changes in chimpanzee populations over time. Perceptions and attitudes of local people towards chimpanzees by examining factors influencing chimpanzee's habitat preferences such as hunting practices, consumption, and the use of body parts in traditional medicine and rituals, and income derived from chimpanzees. And Chimpanzee conservation to explore respondents' opinions on chimpanzee conservation, the laws governing their conservation, and the authorities involved.

During the survey proper, the techniques for data collection were through structured questionnaires, key informant interviews, and focus group discussions. Questionnaires were administered to 251 respondents across twelve villages. The "door-to-door" approach was employed to facilitate data collection and encourage open dialogue, ensuring proportional representation relative to village size. Due to small population size of villages, each individual encountered within a household was interviewed, this helps efforts to balance gender and age categories. Informed consent was obtained from all participants; for respondents aged 15 - 17, parental or guardian consent was sought in accordance with institutional ethical guidelines. Attitudes toward chimpanzees and conservation were classified into three categories—positive, negative, and neutral—based on the content of respondents' answers. Respondents were allowed to select multiple habitat types when reporting perceived chimpanzee use, and these were recorded as separate entries. Missing responses were treated consistently, either excluded from quantitative analysis or coded as "no response" to maintain transparency in data handling.

During the surveys, two teams were formed, each consisting of a lead investigator responsible for conducting interviews, recording GPS coordinates, and data on field sheets, an assistant who helped with interviews and photography; a local guide recommended by the village chief to assist the team through the villages and in translation of the survey questions from French into the local languages when necessary [46]. Before each interview, verbal consent was obtained from all respondents, who were informed that the interviews were anonymous and that they could withdraw at any time. The questionnaire was administered to individuals aged fifteen and older. In each village, interviews began with traditional authorities, such as village chiefs, neighbourhood heads, or elders. Each interview lasted approximately 30 minutes per respondent. The interviews were conducted in French, English, and the local language, and all information was recorded on the data collecting sheet.

2.3. Statistical Analysis

Data obtained from the survey were decoded and analyzed using R software, version 4.1.0 [47]. Descriptive statistics (percentages and frequencies) were first used to summarize respondents' knowledge, perceptions, and attitudes toward chimpanzees and conservation.

Associations between socio-demographic variables and reported knowledge or attitudes were tested using Chi-square independence tests, while descriptive comparisons of categorical responses were conducted with Chi-square homogeneity tests.

To analyse opinions on chimpanzee group sizes (counts), the response variable reported the average group size. The Generalized Linear Model (GLM) with a Poisson distribution was chosen. The predictors tested included 12 socio-demographic and ecological variables (gender, age, ethnic group, primary activity, season of observation, length of residence, sighting period, feeding location, distance to park, chimpanzee behavior, resource exploitation, etc.). Variance Inflation Factors ($VIF < 5$) tested for collinearity; backward stepwise elimination retained predictors that reduced the Akaike Information Criterion (AIC) by ≥ 2 units. Overdispersion was checked using the Pearson χ^2 test.

To analyze the occurrence of hunting (binary outcome: hunting = 1, no hunting = 0) GLM with a binomial distribution model was used to analyse the reported occurrence of hunting. Predictors tested were same 12 socio-demographic and ecological variables as above, with AIC reduction guiding retention of predictors.

To analyse the perceptions of chimpanzee population trends and human-wildlife interactions, embodied response variables such as time elapsed since last sighting, frequency of sightings (occasional vs. regular), seasonal abundance, perceived population change (increase/decrease/stability) consumption of chimpanzees (yes/no) and year of crop destruction (2020/2021/2022). Analysis included, chi-square homogeneity tests compared categorical distributions; independence tests linked socio-economic factors with perceptions where sample sizes permitted.

Respondents were allowed to select multiple habitat types, which were coded as separate entries. Missing responses were either excluded from statistical inference or coded as “no response” to maintain transparency. All analyses were conducted at a 5% significance threshold ($p < 0.05$). Results are presented as percentages, frequencies, tables, and curves, aligned with the study’s specific objectives.

3. Results

After coded data were analyzed, result to assessed local people’s knowledge, perceptions, and attitudes toward chimpanzee habitat preferences in villages adjacent to Douala-Edéa National Park, were presented base on the socio-demographics characteristics of respondents, local knowledge of chimpanzee habitat preferences, perceptions of chimpanzee habitat use, attitudes toward chimpanzee habitat conservation, human-chimpanzee interactions and community support for conservation measures.

3.1. Socio-Demographics Characteristics of Respondents

During the interviews, 251 people were surveyed in 12 villages sampled within the study area. The male respondents were three times more numerous (men, $n = 188$; women, $n = 63$). The ages of the respondents ranged from 15 to 83 years ($\bar{x} = 42.6 \pm 14$, median = 41), and their length of residence in the village ranged from 1 to 71 years ($\bar{x} = 23.2 \pm 15$, median = 20). Four ethnic groups were sampled: the Bakoko (68.1%, $N = 171$), Yassoukou (11.2%, $N = 28$), Yakalag (10.8%, $N = 27$), and Lakalag (10.0%, $N = 25$). Secondary education was the most common level of education (43.0%, $N = 108$), in contrast to higher education (15.9%, $n = 40$) and primary education (39.0%, $n = 98$). Five (2%) respondents had no formal education. Most respondents practiced agriculture as their main activity (46.0%, $N = 116$, **Table 1**), and very few were livestock farmers (0.8%, $N = 2$). Many (84.9%, $N = 213$) acknowledged exploiting natural resources in the park. The villages of the respondents were mostly located 5 - 7 km from the park (reported by 82 respondents). **Table 1** shows the socio-demographic profile of the respondents within the villages sampled around the Douala-Edéa National Park, Littoral-Cameroon.

Table 1. Socio-demographic profile of the respondents.

Variables	Categories	N = 251
	Ekoth	78 (31.1%)
	Elocam	28 (11.2%)
	Abee	22 (8.8%)
	Ndongbiang	22 (8.8%)
	Ongue	22 (8.8%)
	Yambon	18 (7.2%)
Villages	Pongosongo	15 (6.0%)

Continued

	Mouanko	11 (4.4%)
	Lobetal	14 (5.6%)
	Okokong	9 (3.6%)
	Mbangapongo	7 (2.8%)
	mariemberg	5 (2.0%)
	Male	188 (74.9%)
Gender	Female	63 (25.1%)
	Secondary	108 (43.0%)
	Primary	98 (39.0%)
Education level	University	40 (15.9%)
	none	5 (2.0%)
	Bakoko	171 (68.1%)
Ethnic group	Yasoukou	28 (11.2%)
	Yakalag	27 (10.8%)
	Lakalag	25 (10.0%)
	farmer	116 (46.2%)
	Other	50 (19.9%)
Primary activity	Fisher	43 (17.1%)
	Hunter	40 (15.9%)
	breeders	2 (0.8%)
	Yes	213 (84.9%)
Exploited natural resources	No	38 (15.1%)
	5 - 7 km	82 (32.7%)
	7 - 10 km	51 (20.3%)
	3 - 5 km	43 (17.1%)
Distance from village to park	1 km	36 (14.3%)
	3 km	23 (9.2%)
	10+km	16 (6.4%)
Chimpanzee habitat preferences	Dense lowland forest	218 (86.8%)
	Riverine or swamp forests	157 (62.5%)
	Secondary or fallow forests	107 (42.6%)
Seasonal movement of chimpanzee	Towards farmlands	154 (61.3%)
Age (in years)		41 (42.6, 14) 15.0/83
Duration in the Village (in years)		20 (23.2, 15) 1.0/71

N (%); Median (Mean, Standard Deviation) Minimum/Maximum.

3.2. Local Knowledge of Chimpanzee and Habitat Use

Respondents were asked if they knew about chimpanzees, and 98.8% (N = 248) confirmed that they were familiar with chimpanzees, while a minority (1.2%, N = 3) had no knowledge of them and only had a primary school education. Among the 251 individuals surveyed, the majority (88.1%, N = 221) reported having seen at least one chimpanzee in the different habitats in the study area.

Among the 12 predictors tested in the Generalized Linear Model (GLM), eight were effective in improving the model's quality and predicting the group size of chimpanzees generally seen by respondents: gender, age, ethnic group, primary activity of the respondent, observation season, observation period, feeding location, and whether the respondent exploits natural resources. Female respondents reported smaller chimpanzee groups compared to men ($\beta_1 = -0.28$; 95% CI: $-0.50 - -0.06$; $p = 0.014$) (Table 1 and Figure 2(A)). The number of chimpanzees sighted decreased with the respondent's age ($\hat{\beta}_1 = -0.01$; 95% CI: $-0.02 - 0.00$; $p = 0.005$). In other words, younger respondents were more likely to observe more chimpanzees compared to older respondents, as shown in Table 1 and Figure 2(B).

The largest number of chimpanzees seen was reported by the respondents from the Lakalag ethnic group ($\hat{\beta}_1 = 0.58$; 95% CI: $0.29 - 0.86$; $p < 0.001$, Table 1, Figure 2(C)). For example, the reported number was, on average, twice as high as that reported by the Bakoko. Those who reported sighting chimpanzees in both seasons also reported a higher average number of chimpanzees compared to those who observed them during either the rainy or dry season ($\hat{\beta}_1 = 0.24$; 95% CI: $0.05 - 0.43$; $p = 0.011$, Table 1, Figure 2(D)). Alternatively, a chi-square homogeneity test revealed that most respondents reported higher abundance of chimpanzees

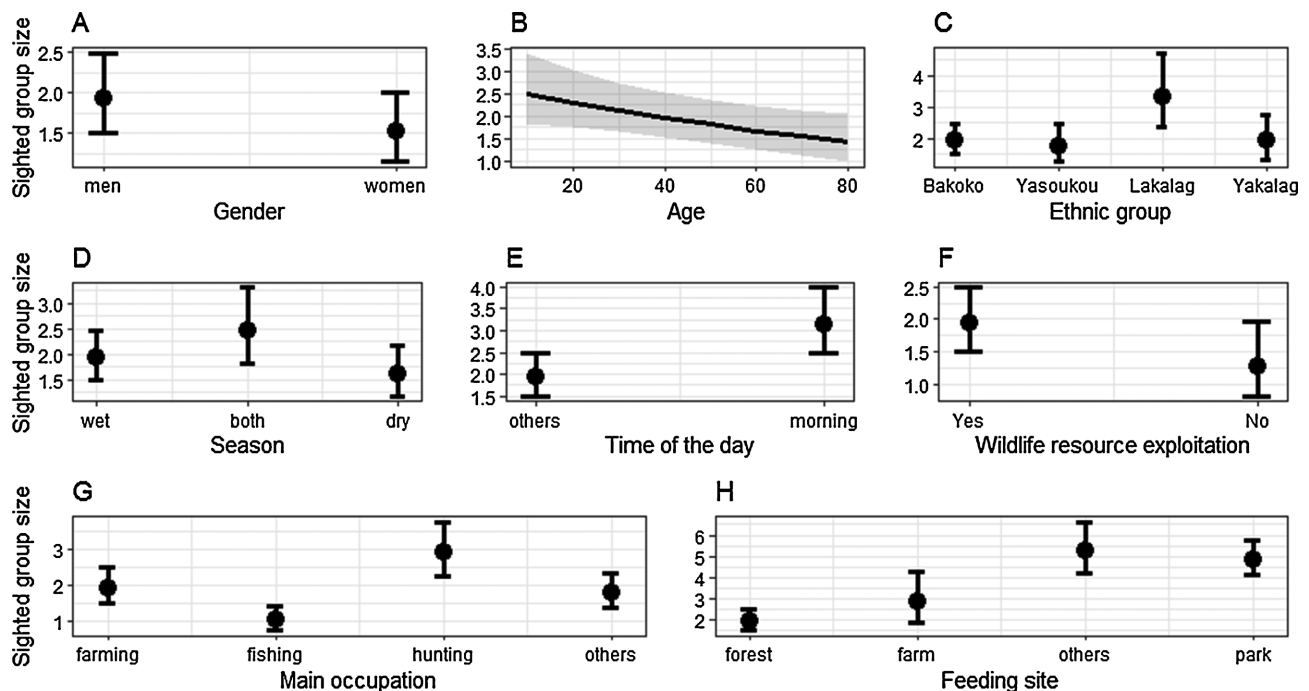


Figure 2. Respondents' opinions on the group size of chimpanzees regularly observed in association with eight predictors.

during the wet season than during the dry season ($\chi^2 = 32.5$, $df = 1$, $p < 0.001$).

Seasonal movement toward farmland during fruiting periods was reported by 61.4% of respondents (**Table 1**). The number of chimpanzees sighted was significantly greater for respondents who observed chimpanzees in the morning compared to those who observed them at other times of the day (afternoon, evening, any time) ($\hat{\beta}_1 = 0.50$; 95% CI: 0.34 - 0.66; $p < 0.001$; **Table 1** and **Figure 2(E)**).

It was found that those who exploited natural resources were approximately twice as more likely to have sighted a larger number of chimpanzees ($\hat{\beta}_1 = 0.57$; 95% CI: 0.20 - 0.96; $p = 0.003$, **Table 1**, **Figure 2(F)**) than those who reported not exploiting natural resources. Hunters were more likely to sight a larger number of chimpanzees ($\hat{\beta}_1 = 0.42$; 95% CI: 0.23 - 0.60; $p < 0.001$) (**Figure 2(G)**) than farmers (the intercept), whereas fishermen were more likely to sight a smaller number of chimpanzees ($\hat{\beta}_1 = -0.61$; 95% CI: -0.86 - -0.36; $p < 0.001$) (**Table 1** and **Figure 2(G)**).

There were only two respondents whose primary activity was livestock farming, and they were not included in the model. Concerning local knowledge of chimpanzee habitat preferences, dense lowland forest was identified as primary habitat by 86.8%, riverine or swamp forests by 62.5% and secondary or fallow forests by 42.6% (**Table 1**). Those who reported that chimpanzees usually feed in their farms within the park or in other areas, reported a significantly larger number of chimpanzees than those who stated that chimpanzees' feeding sites were in the forest (the intercept) (**Table 2** and **Figure 2(H)**). **Table 2** shows the generalized Linear Model reported group size of chimpanzees based on nine predictors (gender, age, respondent's ethnic group and main occupation; season of sighting; sighting time; feeding location; and whether or not the respondent exploits natural resources). And **Figure 2** shows respondents' opinions on the group size of chimpanzees regularly observed in association with eight predictors (gender, age, ethnic group, and main activity of the respondent; sighting season; sighting time; feeding location; and whether or not the respondent exploit park resources).

Respondents were asked about the condition in which they generally see chimpanzees. Among these respondents, 40 people reported having seen them dead, while 90 people reported seeing them alive. Ninety-one (91) people acknowledged seeing them both dead and alive (**Figure 3(A)**). There was a significant difference between the proportions of respondents regarding the time elapsed since their last sighting of chimpanzees ($\chi^2 = 100.47$, $df = 2$, $p < 0.001$). Most sightings were recent (≤ 1 year, 59% of respondents) compared to a longer elapsed time (> 1 year, 41% of respondents) (**Figure 3(B)**), but these sightings were occasional (212 respondents) and not regular (9 respondents) ($\chi^2 = 100.47$, $df = 2$, $p < 0.001$).

When comparing responses across villages regarding recent chimpanzee observations, we found that respondents from Abee, Ekoth, Elocam, Lobetal, Mariemberg, Mbangapongo, Mouanko, Okokong, and Pongosongo reported more frequent and recent sightings than those from Ndongbiang, Ongue, and

Table 2. Generalized Linear Model showing reported group size of chimpanzees based on nine predictors.

<i>Predictors</i>	Dependent variable: group count				
	<i>Estimates</i>	<i>Std.-Erreur</i>	<i>CI</i>	<i>Z-value</i>	<i>p-Value</i>
(Intercept)	0.59	0.24	0.10 - 1.06	2.41	0.016
Gender [Female]	−0.28	0.11	−0.50 - −0.06	−2.45	0.014
Age	−0.01	0.00	−0.02 - −0.00	−2.79	0.005
Ethnic group [Lakalag]	0.58	0.14	0.29 - 0.86	3.98	<0.001
Ethnic group [Yakalag]	−0.02	0.15	−0.31 - 0.27	−0.11	0.915
Ethnic group [Yasoukou]	−0.11	0.11	−0.34 - 0.11	−0.93	0.353
Season [Dry]	−0.16	0.11	−0.37 - 0.05	−1.44	0.148
Season [Both]	0.24	0.10	0.05 - 0.43	2.54	0.011
Period [Morning]	0.50	0.08	0.34 - 0.66	6.13	<0.001
Resource exploitation [Yes]	0.57	0.19	0.20 - 0.96	2.95	0.003
Activity [Others]	−0.08	0.12	−0.32 - 0.15	−0.65	0.513
Activity [Hunting]	0.42	0.09	0.23 - 0.60	4.46	<0.001
Activity [fishing]	−0.61	0.13	−0.86 - −0.36	−4.81	<0.001
Longevity in the village	−0.00	0.00	−0.01 - 0.00	−1.72	0.085
Feeding Location [Farm]	0.70	0.17	0.37 - 1.02	4.18	<0.001
Feeding Location [Others]	0.97	0.13	0.71 - 1.23	7.20	<0.001
Feeding Location [park]	0.90	0.12	0.67 - 1.14	7.39	<0.001

Observations: 190; $R^2 = 0.87$; CI = Confidence Interval.

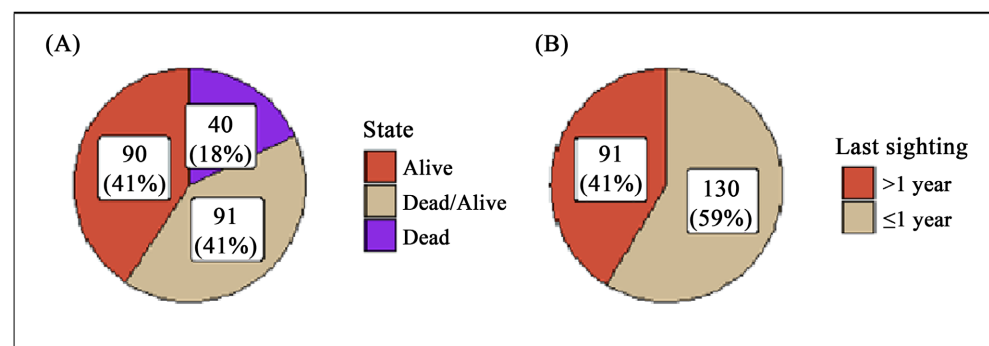


Figure 3. Respondents' opinions on the condition (alive or dead) of chimpanzees regularly observed and also their opinions on the last time they sighted chimpanzees in different habitats.

Yambon (see **Figure 4**). According to the respondents, chimpanzees typically react to human presence by fleeing (169 respondents), attacking (21 respondents), or remaining motionless (30 respondents).

3.3. Perceptions of Chimpanzee Habitat Use by Local People

While 69% perceived chimpanzees as strictly forest-dependent, 31% noted increasing

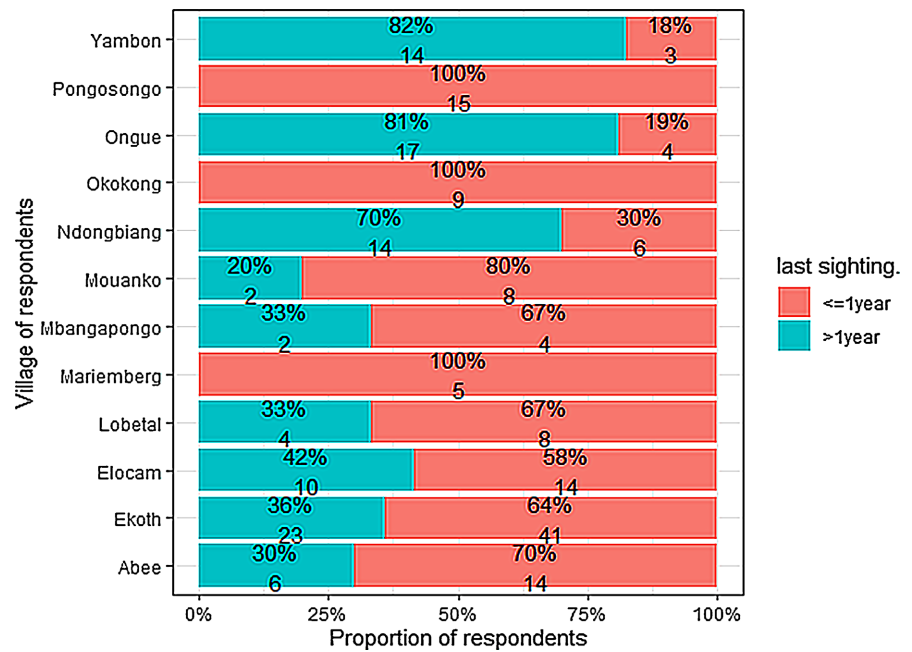


Figure 4. Respondents' opinions on the last time they observe chimpanzees.

chimpanzee presence in farmland and edge habitats. Habitat encroachment was attributed to illegal hunting 79% (presence of numerous hunting camps), forest fragmentation 47% (illegal logging, roads construction and oil exploitation) and forest degradation 36% (Poor agricultural practices and expansion).

Most respondents (78.8%) reported that hunting of chimpanzees occurs in the park. This opinion was significantly influenced by gender, the distance between the respondent's village and the park, and whether or not the respondent exploits natural resources (Table 3 and Figure 5). Men were more likely to report hunting in the park than women (Log-odds = 1.44; 95% CI: 0.66 - 2.24; $p < 0.001$). The farther the respondent's village was from the park, the higher the probability he or she would report hunting in the park (Log-odds = 0.62; 95% CI: 0.37 - 0.90; $p < 0.001$). Respondents who exploited natural resources had a higher likelihood of reporting hunting in the park (Log-odds = 1.77; 95% CI: 0.82 - 2.76; $p < 0.001$).

Table 3 shows binary logistic regression of reported opinions of the existence of

Table 3. Binary logistic regression of reported opinions of the existence of chimpanzee and other wildlife hunting in the Park using three predictors.

Predictors	chasse				
	Log-Odds	SE	CI	Z-value	p-value
(Intercept)	-3.12	0.72	-4.60 - -1.76	-4.33	<0.001
Gender [male]	1.44	0.40	0.66 - 2.24	3.61	<0.001
distance park-village	0.62	0.14	0.37 - 0.90	4.61	<0.001
exploits natural resources [yes]	1.77	0.49	0.82 - 2.76	3.61	<0.001

Observations = 245 ; R^2 Tjur = 0.245; CI = Confidence Interval.

chimpanzee hunting in the Park using three predictors: gender, distance between the park and the village, and whether or not the respondent engages in the exploitation of natural resources. And **Figure 5** shows reported respondent's opinion on wildlife hunting in the Park in relation to gender (A), the distance between their villages and the park (B), and whether or not the respondent engages in natural resources exploitation (C).

The hunted animals included protected species (chimpanzees, elephant, pangolin, terrestrial tortoise, black hornbill) (4 respondents), non-protected species (67 respondents), or all species (128 respondents) (**Figure 6(A)**). Hunting tools were mainly guns and traps (152 respondents, **Figure 6(B)**). None of the respondents acknowledged possessing a hunting permit.

Looking at perceptions of changes in the Chimpanzee population over time, when asked about the variation in the chimpanzee population, there was a significant difference among responses ($\chi^2 = 57.79$, $df = 2$, $p < 0.001$) (**Figure 7(A)**).

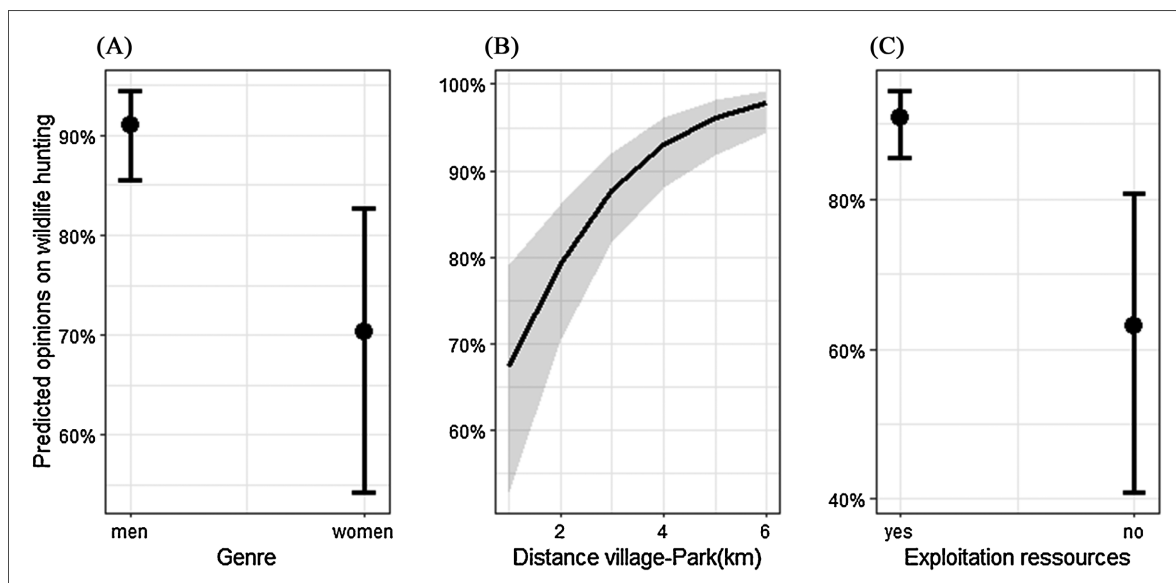


Figure 5. Reported respondent's opinion on wildlife hunting in the Park.

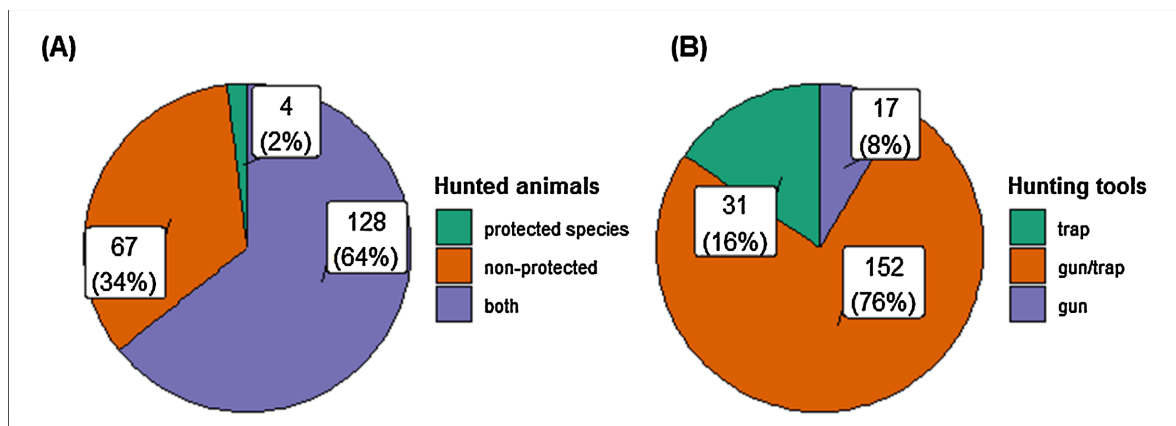


Figure 6. Respondents' opinions on the animals hunted in the Park (A) and the hunting tools used (B).

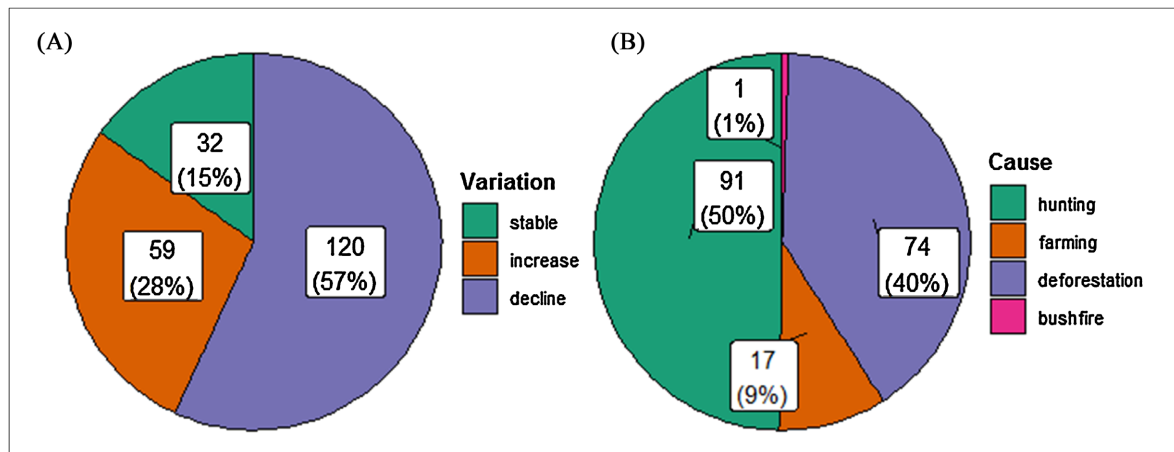


Figure 7. Perception of respondents on the changes in chimpanzee population size over time (A) and the causes of the decline (B).

More than half of the respondents perceived that the chimpanzee population had declined over time (56.9%, $N = 120$). Some respondents believed it had increased (28.0%, $N = 59$), while others reported it was stable (15.2%, $N = 32$). According to most respondents, the main causes of this decline were illegal hunting (49.7%, $N = 91$) and deforestation (40.4%, $N = 74$) (**Figure 7(B)**). To slow this decline in the chimpanzee population, 36 respondents proposed the establishment of income-generating activities, while 7 and 36 respondents suggested the expansion of agricultural land and free management, respectively.

The hunting of chimpanzees and other wildlife was driven by their use as bushmeat for consumption, as well as for traditional medicine, and cultural rituals. Approximately two-thirds of respondents acknowledged having consumed chimpanzee meat ($\chi^2 = 20.08$, $df = 1$, $p < 0.001$) (**Figure 8**). Among those who abstained (90 respondents), the main reason given was the perceived human-like and ancestral nature of the species.

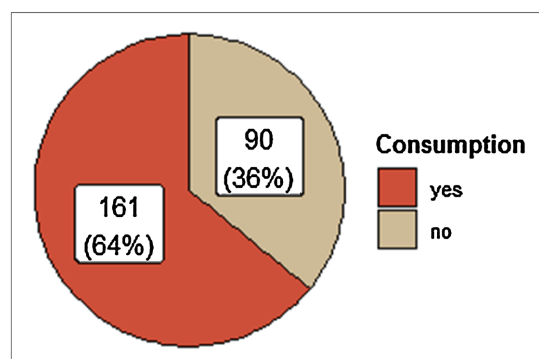


Figure 8. Respondents' opinions on their consumption of chimpanzee meat.

Among the 251 respondents, 74 reported that there was a cultural prohibition against using chimpanzees, believing that doing so could lead to disasters or curses. However, 60 of them acknowledged having consumed chimpanzees, while

14 said they refrained from consuming them. Similarly, 73 of the 251 respondents (29%) agreed that there exist taboos against chimpanzees. However, 80.8% (N = 59) of the 73 respondents still reported eating chimpanzees. This belief was most commonly associated with the Bakoko ethnic group, while the Lakalag, Yakalag, and Yasoukou ethnic groups showed little to no such beliefs (**Figure 9(A)**).

Most respondents (64.1%, N = 161) reported using chimpanzees for the traditional treatment of diseases. Five body parts were used, with bones being the most commonly utilized (51.7% of respondents, N = 74, **Figure 9(B)**). These treatments targeted seven ailments (**Figure 9(C)**), namely: gallbladder disease (N = 19), sprains (N = 7), spiritual attacks (N = 7), fractures (N = 7), infections (N = 7), headaches (N = 3), and massage (N = 1). Three of the 251 respondents acknowledged selling chimpanzees. **Figure 9** shows proportions of respondents on the cultural belief of chimpanzees as a taboo associated with their ethnic groups (A); frequency of respondents regarding the chimpanzee body parts used (B) and the illnesses treated (C).

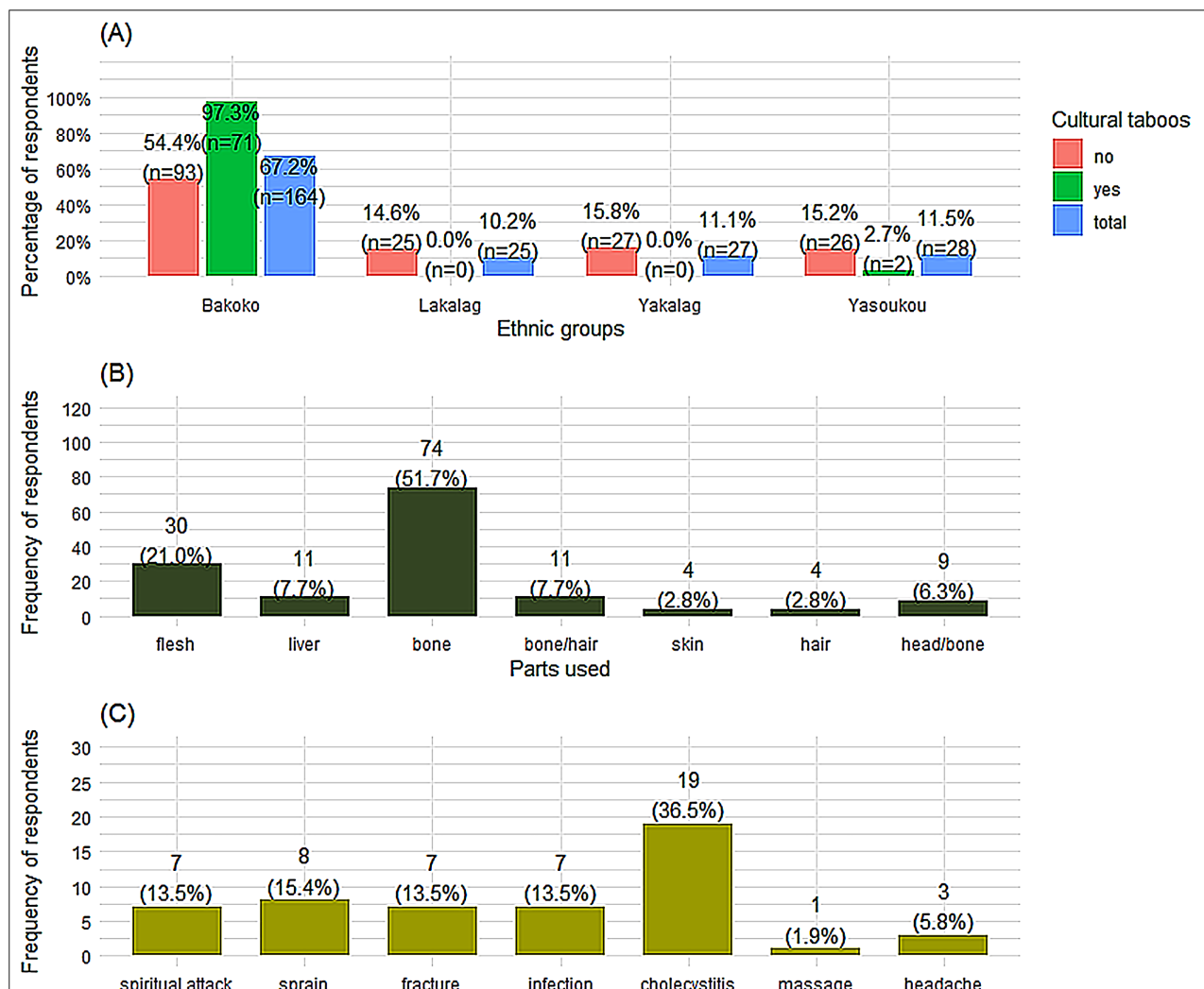


Figure 9. Proportions of respondents on the cultural belief of chimpanzees.

3.4. Attitudes toward Chimpanzee Habitat Conservation and Knowledge of the Law

Attitudes toward chimpanzee habitat conservation varied, majority of respondents 88% (N = 221 out of 251) were positive, 11% (N = 28 out of 251), were negative and 1% (N = 3 out of 251) were neutral towards chimpanzee conservation. Positive attitudes were linked to with ecological awareness and cultural importance, whereas negative attitudes were linked to crop damage. Most of the respondents were also aware of a law protecting chimpanzees 92% (N = 231 out of 251) as compare to 8% (N = 20 out of 251) who said they aren't aware. When asked about the ownership of the park, almost half of the respondents 48.8% (N = 117 out of 240) stated that it belonged to the state, while some 22% (N = 53 out of 240) said it belonged to the local community, or was for everyone 8.8% (N = 21 out of 240) and only 4.6% (N = 11 out of 240) of respondents had no idea.

3.5. Human-Chimpanzee Interactions.

Human-chimpanzees interactions were reported by 75% of respondents, mainly at forest-farm boundaries. Human-chimpanzee conflicts were primarily related to crop raiding primarily affected bananas, and maize, as reported by most respondents (N = 170 out of 228). A total of 170 respondents acknowledged being victims of such damage, but none had received compensation for these losses. As such, respondents experiencing crop damage were significantly less supportive of conservation. While members of the Lakalag and Yakalag tribes reported little or no conflict with chimpanzees, the Bakoko and Yasoukou tribes were the most affected by the conflict (**Figure 10(A)**). The reported crop raiding varied significantly from 2020 to 2022 ($\chi^2 = 168.57$, $df = 2$, $p < 0.001$) (**Figure 10(B)**). The destruction was highest in 2020 and lowest in 2021.

3.6. Local People's Support for Conservation Measures

Despite reported human-chimpanzees conflicts, 69% of respondents expressed willingness to support conservation measures if livelihoods were considered. Preferred strategies reported by respondents included participatory management (45%), compensation for crop damage (33%), and awareness programs (22%). Some respondents suggested implementing income-generating activities, while others proposed expanding agricultural land and allowing freer access to Park resources.

4. Discussion

The sustainable conservation of natural resources and biodiversity is more effective when local populations, as well as environmental advocates, are involved. These groups understand the relationships and interactions between the local population, the natural environment, and its wildlife [48]. A positive attitude of the local population toward wildlife and conservation is a key factor in the survival and management of threatened species [49] [50]. To this end, it is crucial

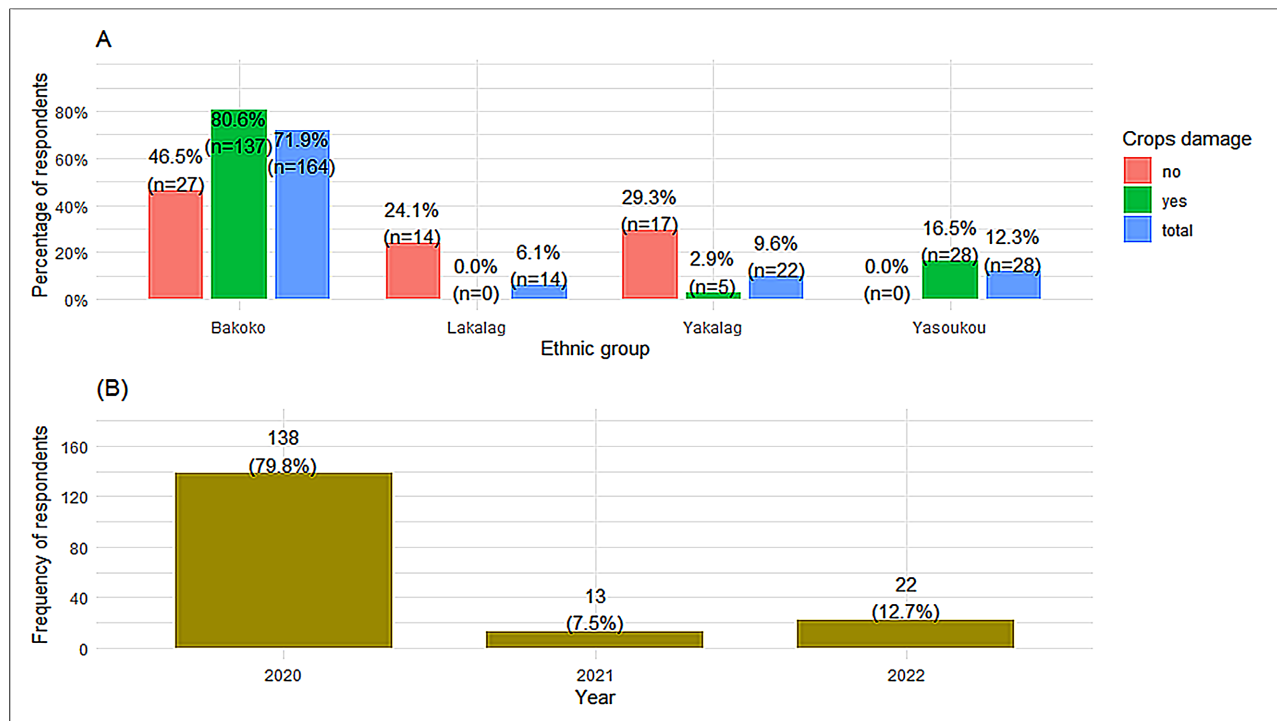


Figure 10. Proportions of respondents on crop destruction in association with their ethnic groups (A); and frequencies of respondents on the year of crop destruction (B).

to gather baseline data on the knowledge, perception, and attitude of the local population regarding conservation, as well as the extent of human-wildlife conflicts [51]. Such data is lacking for chimpanzee conservation initiatives in the Douala-Edéa National Park. This study provided valuable information that will contribute to planning conservation measures for chimpanzees and biodiversity in general.

4.1. Socio-Demographic Profile of Respondents

The survey conducted in 12 villages surrounding the Douala-Edéa National Park revealed a predominance of male respondents, with the number of men being three times higher than that of women. These findings align with those of [41], where men outnumbered women. The average age of the respondents was 42.6 years, with a median age of 41 years, while their length of residence in the villages varied, with an average of 23.2 years and a median of 20 years. These align with [52] report which indicated that the population in the area was relatively young, presenting both challenges and opportunities for wildlife conservation. Similarly, [29] noted that a young population can be a disadvantage, as young adults, constantly seeking livelihoods, are often tempted by activities such as poaching. However, this demographic also presents an opportunity, as youth can be mobilized for awareness campaigns against chimpanzee hunting, as demonstrated by studies conducted by [35]–[53]. Furthermore, the study shows that agriculture is the main source of income for residents of the surrounding villages. As in many other regions of Cameroon [54], farmers in this area often clear forested land to establish

new plantations.

4.2. Local People's Knowledge of Chimpanzees and Habitat Use

This study demonstrates that local people surrounding Douala-Edéa National Park possess substantial knowledge of chimpanzee habitat preferences. Respondents correctly identified dense lowland forests, riverine and swamp forests, and fruiting secondary forests as key habitats. This finding aligns with previous research in Central Africa, where chimpanzees are shown to prefer forested habitats with high fruit availability [55]-[56]. Among respondents, 98.8% reported being aware of these primates, and 88.1% had observed them in the study area. Men, young adults, and less-educated residents reported more frequent sightings chimpanzee in their habitat preferences. This trend could be attributed to their higher levels of outdoor activity, often near the Park. [57] noted that individuals with higher levels of education tend to work outside agricultural and hunting sectors, reducing their opportunities to encounter chimpanzees in the forest. Male respondents demonstrated a higher knowledge of chimpanzee habitat preferences than females, a finding consistent with [58], who noted that women report fewer observations, mainly due to their social roles. Domestic tasks typically assigned to women contrast with the outdoor activities of men, such as hunting, fishing, and farming, which provide more opportunities for interactions with chimpanzees [59]. The gender imbalance in these findings can also be attributed to the higher number of male respondents compared to females [58]. Additionally, some women expressed reluctance to participate in interviews, while others outright declined, stating they had no knowledge of the forest, as it is traditionally considered the domain of men. Similar findings were reported by [41] in Mpem-Djim National Park.

Observations of chimpanzees also declined with the age of respondents, as younger individuals generally see fewer chimpanzees than older ones who frequent chimpanzee's habitats. The significant association between length of residence and knowledge suggests that long-term exposure enhances understanding of wildlife behavior, reinforcing the value of integrating local ecological knowledge into conservation planning. Members of the Lakalag ethnic group reported observing larger chimpanzee groups, on average twice the size of those observed by the Bakoko. This is likely due to their proximity to the islands, where chimpanzees are easier to spot due to their territorial nature, limited range, and restricted movement caused by water barriers. Respondents who observed chimpanzees during both seasons (rainy and dry) reported larger groups than those who only observed them during one season. However, most sightings occurred during the rainy season, likely due to the high productivity of many fruiting trees during this period. Seasonal shifts in chimpanzee movement, reported by respondents, corroborate ecological studies indicating that chimpanzees adjust habitat use according to fruiting phenology and water availability [60].

The distribution of observations varied significantly with time. Statistics on the

timing of the last observation revealed that a majority (59%) had seen chimpanzees within the past year, while 41% reported sightings over a year ago. Most of these observations were occasional, as indicated by 212 respondents, while only nine reported regular sightings, reflecting the infrequency of encounters for most respondents. Villages farther from the Park reported less recent sightings. In terms of chimpanzee behaviour toward humans, wild chimpanzees tend to flee, whereas those in semi-natural habitats are more likely to display aggression. The significant correlation between proximity to the park and reports of farmland incursions indicates that local spatial context influences perceptions, emphasizing the need for location-specific management interventions.

4.3. Perceptions of Local People towards Chimpanzee Habitat Use

Local people's perceptions revealed a nuanced understanding of chimpanzee ecology, but also reflected awareness of habitat encroachment. Approximately 61.3% of respondents perceived chimpanzees moving into farmland and edge habitats, highlighting local recognition of human-induced habitat modification. Such perceptions are consistent with studies in Nigeria and Cameroon, where forest degradation and agricultural expansion drive increased human-chimpanzee interactions [61]. Equally, precarious living conditions, marked by poverty and low income, threaten the survival of chimpanzees as local populations resort to exploiting resources within chimpanzee's habitats preferences. These findings align with studies by [32], which emphasize that such conditions often lead communities to overlook conservation efforts. Most respondents reported that hunting occurs in the Park. The likelihood of admitting to excessive hunting was higher among respondents from villages farther from the Park compared to those living nearby, who are often the primary exploiters of the Park's resources. Similar results have been observed in other regions of Cameroon [41].

Given the sensitivity of illegal activities, respondents are often reluctant to disclose information, especially to individuals perceived as linked to local authorities or environmental defenders. This suggests that the actual extent of hunting could be even greater than reported. Approximately three-quarters of the population hunts various species indiscriminately, contributing to habitats deterioration and the decline of many threatened species, including chimpanzees and turtles. Hunting methods primarily involve traps due to the difficulty of encountering chimpanzees as they are considered to be very intelligence. None of the respondents reported holding a hunting permit, confirming that these activities are conducted illegally and without regulation.

More than half of the respondents indicated that the chimpanzee population has declined over time, a trend also highlighted by [28]. Conversely, respondents who claimed the population was increasing were mostly from villages near islands hosting chimpanzees reintroduced by the NGO Papaye International. The success of this initiative lies in the reproduction of these reintroduced chimpanzees. Illegal hunting and deforestation were identified by most respondents as the main causes

of the population decline. This contrasts with [41], who suggested that the reasons for the decline were uncertain, though poaching was suspected, and some respondents attributed it to agricultural expansion.

The hunting of chimpanzees and other wildlife is primarily driven by their use as bush-meat for consumption, as well as for traditional medicine and rituals, consistent with observations by [35]. About two-thirds of respondents admitted to consuming chimpanzee meat, though only a few acknowledged direct involvement in hunting. Those who refrained from consuming chimpanzee meat justified their choice by citing the animal's human-like and ancestral nature, contrasting with [41] findings, where respondents referred to religious prohibitions. Few respondents mentioned cultural prohibitions regarding the use of chimpanzees. However, as in other parts of Cameroon as reported by [31], certain taboos persist. Some believe that chimpanzees carry curses or are harbingers of misfortune. For instance, their distress calls are seen as omens of village calamities, and encountering a dead chimpanzee on one's path is considered a sign of impending disaster for the individual or their family. The most common ritual involves using chimpanzee bone powder to wash and purify new-borns, believed to transfer the animal's strength. Many respondents also reported the use of chimpanzees in traditional medicine, consistent with findings by [39]. Five parts of the chimpanzee's body are primarily used to treat seven types of ailments: bones for sprains and fractures; the liver for bile-related diseases; the skull for headaches and infectious diseases; and, in some cases, for protection against spiritual attacks.

4.4. Community Attitudes toward Chimpanzee Habitat Conservation and Understanding of Environmental Laws

Local people's attitudes toward conservation were mixed, reflecting the interplay between ecological knowledge and direct human-wildlife conflict. Positive attitudes predominated among respondents aware of the ecological or cultural importance of chimpanzees, whereas negative attitudes were linked to crop raiding and perceived restrictions on forest access. These findings echo other studies in Africa showing that direct economic impacts are a key determinant of local attitudes toward wildlife [62]. Importantly, a majority of respondents expressed willingness to support conservation measures if their livelihoods were safeguarded, suggesting that community-based strategies and mitigation schemes could foster coexistence, a perspective that aligns with the findings of [38].

Most respondents were also aware of the existence of laws protecting this species. However, the communities in villages surrounding the Douala-Edéa National Park express significant dissatisfaction with its management system, a stance that contrasts with the findings of [35] in the Tofala Wildlife Sanctuary in southern Cameroon. Additionally, there is no meaningful collaboration between local populations and the authorities managing wildlife, contrary to the situation observed by [39] in the Mbam-Djerem National Park, where numerous complaints were

directed toward eco-guards and the government, reason why most chimpanzee's habitats preferences are deteriorating. Local populations express discontent largely due to the confiscation of their lands when the reserve was transformed into a National Park. They also report abuses of power by eco-guards, who frequently seize their tools, including machetes, guns, firearms, mechanical saws, and chain-saws. These conflicts between local communities and conservation agents pose a significant threat to the survival of chimpanzees and wildlife in general.

4.5. Human-Chimpanzee Interactions and Conservation Implications

Human-chimpanzee conflicts are primarily linked to crop raiding, particularly involving bananas, maize, and cassava, a problem similar to that reported by [63] in the Kosi Tappu Wildlife Reserve in southern Nepal, where locals, facing damage caused by wild buffalo, held negative attitudes toward the reserve and had never received compensation. In the case of the Douala-Edéa National Park, the Lakalag and Yakalag tribes report minimal or no conflicts with chimpanzees, while the Bakoko and Yasoukou tribes consider themselves significantly affected. Reports of crop destruction varied significantly between 2020 and 2022, with the highest incidents occurring in 2020 and the lowest in 2021. Such interactions reinforce the need for mitigation measures, including buffer zones, early-warning systems, and community compensation programs.

4.6. Community Participation and Support for Conservation Efforts

To slow the decline of chimpanzee populations and habitats preference deterioration, the integration of local knowledge into conservation initiatives can improve the effectiveness of habitat protection strategies, as communities are often best placed to identify critical habitats and seasonal movement patterns. Furthermore, participatory approaches in forest management may reduce negative attitudes and increase local stewardship [64]. Furthermore, some respondents suggested implementing income-generating activities, while others proposed expanding agricultural land and allowing freer access to Park resources. All these highlight critical aspect for the success of conservation initiatives.

5. Conclusions

This study aimed to evaluate local knowledge, perceptions, and attitudes toward chimpanzee habitat preferences in villages surrounding Douala-Edéa National Park, Littoral-Cameroon. Specifically, the study sought to assess local knowledge of chimpanzee habitat preferences, explore perceptions of habitat use and human-chimpanzee interactions. And to examine attitudes toward conservation and potential mitigation strategies. Local people demonstrated substantial knowledge, identifying dense forests as primary chimpanzee habitats rich in resources and whose preservation is critical for their survival compared to riverine/swamp for-

ests and secondary/fallow forests. Seasonal movement of chimpanzee toward farmland during fruiting periods was reported. Knowledge of habitat preferences was significantly higher among long-term residents.

Disparities in the distribution of conservation benefits influence local people's perceptions, especially as chimpanzees were reported moving into farmlands which reflected awareness of habitat fragmentation and human disturbance. Habitat encroachment was attributed to illegal hunting or poaching driven by consumption, commerce, traditional practices, and rituals, and forest degradation due to agricultural expansion declining chimpanzee population and habitat preference. Proximity to the park influenced reported sightings, indicating that local spatial context should guide targeted management. Attitudes were influenced by both ecological knowledge and crop raiding experiences. Positive attitudes predominated among respondents recognizing ecological or cultural value, whereas negative attitudes were linked to economic losses (crop damage) and restricted forest access.

Interactions with respondents, mainly at forest-farm boundaries show that crop raiding remains the primary source of conflict, particularly involving bananas and maize. Respondents experiencing crop damage, were significantly less supportive to conservation of wildlife. In the face of reported human-chimpanzees conflicts and persist misconceptions hindering effective habitat management. Majority of respondents expressed willingness to support conservation measures and to abide by existing laws if livelihoods were considered. Preferred strategies reported by respondents included participatory management, compensation for crop damage, and awareness programs. Some respondents suggested implementing income-generating activities, while others proposed expanding agricultural land and allowing freer access to Park resources.

To ensure the long-term survival of chimpanzees and protection of their habitats preferences in the Park, it is essential to raise local community awareness on the threats and ecological importance. Incorporating local people knowledge into habitat mapping and conflict mitigation strategies, including compensation and participatory management, are essential to foster coexistence. To strengthen direct understanding of local perceptions of chimpanzee habitat preferences in the Douala-Edéa National Park, future field research should combine; structured social surveys on local ecological knowledge about chimpanzee habitat and distribution, spatial tracking and camera trapping to identify areas of frequent use by chimpanzees and participatory mapping with local communities to ground perceived habitat preferences with observed chimpanzee presence.

Author Contributions

Mvo Denis Chuo: Conceptualization; methodology; data collection and analysis; writing a grant proposal; preparing the original and final draft. Sime Tchuente Winny Laetia: Conceptualization; methodology; data collection; project administration; writing and editing the draft. Jean Pascal Koh Dimbot: Data analysis and

editing the final draft. Theodore B. Mayaka: Supervision; contributed critically to the drafts. All authors gave their final approval for publication.

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Data Availability

The datasets generated and analyzed for the current study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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