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Title

Local Perceptions on Conservation of Wild Chimpanzees *(Pan troglodytes verus)* in the Réserve Naturelle Communautaire de Dindéfélo, Southeast of Senegal

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Abstract

The objective is to study the local perceptions on the conservation of wild chimpanzees *(Pan troglodytes verus)* in the Réserve Naturelle Communautaire de Dindéfélo (RNCD), southeast of Senegal, to design specific actions to improve conservation management. We conducted 338 semi-structured interviews in three main villages of RNCD. Three-fourths of the population were farmers. Of those interviewed, 29% received elementary education. Two of the three villages participated in a project to plant trees as fences. On average, 66% of the respondents were animists. Of the respondents who were afraid to see a chimpanzee, 68% answered because they attack. Seventy-seven percent washed their clothes in the forest river because there was more water than in the village wells. Of the interviewees who threw the old clothes into the forest, 50% did it due to tradition. Ninety-six percent of respondents stated that chimpanzees do not feed from their crops. The main problems of the locals with the Reserve were lack of water and basic resources and not been allow to cut trees in protected areas. There were significant relationships between education (1

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relationship), environmental project (4 relationships) and animism (11 relationships) with local perceptions. The 93% of the respondents who had the traditional belief that "if the old clothes were burnt, children would become sick" feel fear of chimpanzees, while those who did not have this animistic belief the 6% are afraid (χ^2 = 1.57, P < 0.02). These local perceptions allow us to design specific course of action to improve chimpanzee conservation and sustainable coexistence in this complex period of the Anthropocene.

Keywords

local perceptions; chimpanzees; conservation; natural resources; human-chimpanzees conflict; traditional beliefs

Abbreviations

Réserve Naturelle Communautaire de Dindéfélo (RNCD)

International Union for Conservation of Nature (IUCN)

Instituto Jane Goodall España (IJGE)

1. Introduction

Currently we are experiencing a crisis of biodiversity due to the extinction of species, habitat destruction and fragmentation, land conversion for agriculture, climate change and pollution. Every day, biodiversity is lost at a rate of up to a thousand times the natural rate, according to the International Union for Conservation of Nature (IUCN) [1]. There is a strengthening of the hypothesis that the natural world is experiencing the sixth major extinction in history [2,3].

Research and conservation management needs studies on the perceptions of the local population to design guidelines that promote sustainable co-existence between humans and wildlife [4-10]. Working with local people is essential because they have specific knowledge of the area and manage natural resources. Also, if psychological variables are known, this can facilitate how to generate changes in behavior and habits in people, according to the theory of Ellis [11,6,12]. Conservation is complex and requires multidisciplinary work where the social sciences play an

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important role in effective management of the biodiversity [6,13,14,15,16,17]. Human activities are one of the main causes of extinction of the primates on our planet because of population growth, increase market demands, agricultural expansion, logging, mining, fossil fuel extraction, hunting, climate change, illegal trades, among others. There is an increase in human-chimpanzee conflicts. The ethnoprimatological fieldwork is an effective tool to identify specific problems and workable *in situ* solutions for primate conservation [2,18-21]. A biosocial approach to understanding the interactions between humans and wildlife implies an openness and flexibility that provides more effective results for a sustainable co-existence [22].

Ethnoprimatology is a powerful tool and a new approach to primate studies in the Anthropocene because there is a global and fast challenge that causes primates and humans to co-exist and interact. Humans influence primates and *vice versa*, for example, human-primates interface such as expansion of agriculture and crop foraging, pathogen transmission or new tourism, among others [23,19]. This interface is global, from the Neotropics, Africa and Asia [2]. In Uganda, researchers [24,15,9,17] have studied interactions between chimpanzees and local people concerning crop foraging and, thanks to local perceptions, they were able to design specific programs to mitigate conflicts. In Guinea-Bissau, studies have been carried out on the interaction of human chimpanzees in crops from an anthropogenic and ecological perspective to manage the attacks on people and the loss of habitat [11,18,20].

Several research papers in ethnoprimatology study relationships among variables such as gender, age, education and economic level, among others, with the perception about conservation [11,25]. Gadd, in 2005, studied local attitudes towards elephant conservation in Kenya and took into account the education and wealth of the local people. Estrada took into account multiple factors in the extinction of species such as population increase, high levels of poverty and inequality, global market, literacy or education, among others [2]. In the Réserve Naturelle Communautaire de Dindéfélo (RNCD), children often have to help the family at home with housework and labor, such as farming fields, so that they often do not go to school.

The RNCD area is one of the poorest and various NGOs assist in health, education and environment, among others. Trees for the future is a project to revitalize lands damaged by deforestation. They provide tree seed to farmers, technical training and on-site planning assistance. Over 115 million trees have been planted in dozens of countries of the world and hundreds of thousands of acres of soil revitalized while changing people's lives. In the RNCD, the project has been working a few years in the

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village of Segou, Nandoumary was newly incorporated into the project, and Dindéfélo was not participating in the project yet. Locals learn to plant trees to use as fences for their homes and crops.

In Senegal, traditional beliefs prevailed until the Muslim religion arrived. Now they live together although animism is hidden more. This coincides with other research in other countries such as Guinea-Bissau, where they studied local perceptions about the conservation of chimpanzees in Muslims and non-Muslims, if they considered that animals and forests are forever or if they could be extinguished and what they thought about the chimpanzees, whether they are good or bad [26,11,6]. In Senegal, the Peul/Fulbe/Fula/Fulani ethnic group tells stories, for example, like a long time ago a mother was with her baby in the forest when a chimpanzee with her baby approached. The chimpanzee came and took the baby from the woman. The mother chimpanzee killed the human baby, gave it back to the woman, and left. Another story told among the Peul is that if you walk through the forest and you find a chimpanzee with a gesture of attack, when you come home someone in your family will have died. They are death beliefs related to chimpanzees that coincide with other countries and affect conservation. When NGOs explain their programs to help chimpanzees, many locals do not understand it for this reason [20].

The chimpanzee *(Pan troglodytes)* is an endangered species, according to the IUCN Red List in 2008. This species has suffered a significant reduction in population over the last 20-30 years due to loss of habitat, human population growth, diseases like ebola or political instability in some regions. The current trend of this species is declining. The latest estimation of the total population size of the *Pan troglodytes verus* is 21 300 to 55 600 in West Africa. In Senegal, this species is close to extinction. *P. t. verus* is one of the most endangered subspecies [27]. Butynski, in 2001, estimated a population of 200-400 chimpanzees in Senegal. In a census conducted in the RNCD, it has estimated 36-91 chimpanzees in 2014 [39].

In the RNCD, as well as in other countries, there is great human presence in the forest and numerous encounters between humans and wildlife [28,18,9,10]. Many people are inside or within the limits of the Reserve. It is one of the poorest regions of Senegal, which means that people use forest resources such as water and trees to survive [10,29-32]. The river water is used for drinking, washing clothes and bathing. The forest is used as the town dump and latrine. Additionally, trees are cut down for building houses. Also, every year large areas of forests are burnt to open new fields for crops, as in other research areas [28,18,33,34].

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These resources are essential for the survival of chimpanzees. In the dry season, with high temperatures and water shortages, an increased number of encounters between humans and chimpanzees in small gallery forests are reported [28,10]. Previous studies in the Reserve show that the local population in 6 of the 10 villages seems to have constant conflicts with chimpanzees at water points [10]. Besides, the fruits of March-April are only found in gallery forests. Chimpanzees are forced to be in close proximity to humans, less than 30 meters. This is compounded by a great increase in uncontrolled tourism to cool off in Dindéfélo waterfall. In May, for instance, 300 tourists arrived in 30 minutes (personal observation). Another example of natural resources competition is that, in June, the diet of chimpanzees is basically the fruit of lare *(Saba senegalensis).* However, the local population collects tons illegally to trade in local and national markets [35,18,10,36-38]. In 2014, only 25 tons of *S. senegalensis* were collected legally [39]. Throughout the year, trees are cut down; this presents the chimpanzees with a problem because they build their nests in these trees. By burning forests, chimpanzees lose their food, resting areas and, finally, their habitat [29].

The RNCD would be an example of the problem of conservation of chimpanzees. In this area, the Peul ethnicity dominates [10,32]. This ethnic group has changed from nomadism to a sedentary state. Many people are unaware of the official laws and are governed by local tradition. Islam co-exists with animism, in the original Peul religion, which is still present. The total population has increased in the last five years to a total of 1 236 inhabitants. The extended family is an economic model of subsistence. The local economy hardly exceeds the limit of subsistence and is based on agriculture, logging and livestock [29,39].

The objective of the research is to study the local perceptions to draw lines of action to improve the management of chimpanzee conservation in RNCD. It is therefore interesting to investigate whether there is competition for natural resources and delve deeper into the psychological thought-process to understand the motivation of the population variables. The main goals are to investigate whether the local population perceives natural resources as a competition with chimpanzees and to design specific lines of action to improve conservation management and sustainable coexistence in this complex period of the Anthropocene.

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2. Methods

2.1. Study area

The RNCD (12º24'N, 12º18'W) covers an area of 14 050 ha. It is located in the region of Kedougou, in the extreme southeast of Senegal. The RNCD borders Guinea-Conakry to the south, the Gambia River to the east and, to the north with small towns and farmland [10,40]. It is The Sudan savannah and The Guinean forest that make up a mosaic of patches of forests, crops and pastures. The Sudan savannah consists of grasslands with patches of trees interspersed with lateritic soils. The Guinean forest is made up of semi-deciduous forests, canyons and drainage galleries [10,32].

This savannah-forest mosaic is the result of human activities such as logging and fires. The population depends on forest resources. On the Reserve, 10 villages with 6 951 inhabitants and 651 houses are distributed [10]. The total population has been increasing in recent years. Due to a subsistence economy, locals open crops in poor soils every year, extract fruits to sell them and their cattle feed in the forests. Faced with water scarcity, the inhabitants of the protected area flock to the rivers of the forests.

2.2 Interviews

We conducted 338 semi-structured interviews in three of the 10 villages of RNCD because they were the sites of research of the Instituto Jane Goodall España (IJGE). The three villages had different storage characteristics. Dindéfélo is a tourist small town in Senegal, and its population lives close to the forest. Segou is characterized by how its local people cooperate with conservation, and Nandoumary is noted for its deforestation and lack of resources. Forests of Segou and Dindéfélo are in the limits of the Reserve, and Nandoumary is inside the protected area.

Before anything else, permission from the heads of every village and the authorities was asked by means of the presentation of the research and following the social and cultural protocols of their ethnicity. Interviews were conducted with the help of several local interpreters, French to Pular (local language), in each village. Before the interviews, the interpreters were trained on how to do surveys. A preliminary study was performed to investigate the traditional beliefs with the help of locals. Some of the information obtained in the interviews was by living with local people two years and the reliable help of local people.

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The houses where the interviews were conducted were chosen randomly. In each house the husband, the wife, the grandparents and the teenage son of a family were interviewed to study possible generational differences. The age of 15 years old was chosen because it is when youngsters begin to marry.

Before the interview, an informed consent from the volunteer was requested. Surveys were performed individually to maintain everyone´s confidentiality. In a socio-economic study by the IJGE in 2014, in the group surveys men generally answered and women were silent, so an individual interview was chosen to enhance the participation of women.

Information was asked regarding how locals perceived chimpanzees, the three variables of Ellis (feelings, thoughts and behaviors) [12] when they saw a chimpanzee, possible competition for water from the river, if there was problem of deforestation, whether chimpanzees fed their crops, among others (Table 2). The answers were 3 options (yes, no, unsure) except of the last question, which was open for them to explain problems and possible solutions. The average duration was 30 minutes per interview. The interviews were conducted from March to November 2015.

Also comments on the respondent´s attitude and nonverbal behavior were written down. Likewise, information has also been taken into account outside the interviews, such as co-existence with local people, conflicts, meetings, events, local workers´ opinions of IJGE and observations of land-use and human-chimpanzee interactions.

2.3. Statistical analysis

Percentages of the characteristics of the local population and interview answers about the conservation of chimpanzees were calculated. Chi-squared tests were used to investigate whether there was an association between some characteristics of the local population and the most representative questions of chimpanzee conservation. Due to the large amount of data, the most representative questions were selected to calculate the associations between the local perception on conservation of chimpanzees with education, Trees for the Future project and animism. Statistical analysis were performed with SAS. The significance level considered was $p < 0.05$.

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3. Results

3.1. Characteristics of the local population

Ten percent of the local population was interviewed in each village (Dindéfélo = 209; Segou = 101; Nandoumary = 28). Fifty-three percent of those interviewed were women and 47% were men. Forty-seven percent of respondents were under 30 years old, 34% between 31 and 45, 12% between 46 and 60 and 7% were older than 60. The average number of women per husband was one. The average number of children per family was four. Also three-fourths of the population were farmers. On average, 66% of the respondents were animists (Table 1).

Of those interviewed, 29% received elementary education. Elementary education varied significantly depending on the gender of the respondents, the village and the age. Sixty-seven percent of the men and 33% of the women have gone to school (χ^2 = 22.81, P <0.0001). In Dindéfélo, 25% of the respondents have not received elementary education, whereas in Segou the percentage was 70%, and in Nandoumary 75% (χ^2 = 49.73, P <0.0001). Furthermore, 56% of the population between 46 and 60 years old have not gone to school, as opposed to 29% aged between 15-30 who have gone to elementary school (χ^2 = 44.24, P <0.0001).

Depending on the village, the percentage of respondents who participated in Trees for the Future project varied (χ^2 = 158.66, P <0.0001). Forty-five percent of the respondents from Segou participated in the formation, whereas 18% of the respondents from Nandoumary, and 0% of the one of Dindéfélo, did this formation.

3.2. Questions about chimpanzee conservation

The results indicate differentiated responses in the questions on the conservation of chimpanzees (Table 2). Fifty percent threw old clothes in the forest by tradition, as they had always done so. Of this percentage, 20% regarded the forest as the town dump, 6% did not want to throw old clothes away at home because their cows ate it and died, 4% put the old clothes on the branches of trees to not burn and 3% did it because the marabou said to (priest in animism).

With respect to the trees, 96% of respondents said that chimpanzees do not feed their fields of crops, but rather baboons did *(Papio papio),* so local people shot them. Seventy-one percent of respondents, when they looked for fruits of the forest and

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did not find them, did not blame chimpanzees but did blame the baboons. Ninety percent of respondents would like to keep their livestock inside a fence all year, but they needed food and water and local people could not afford this.

The main problems of the locals with the Reserve are: 1) lack of water (35%); 2) lack of basic resources such as food, health, education, work and electricity (17%), and 3) logging, not being allowed to cut trees in protected areas (15%). Thirty-two percent answered that there was no problem. In interviews, Peul people were shy, willing and trying to avoid conflicts. If the question is formulated as "is there any problem?", most respondents answered “no”. But, if asked "what can the Reserve do to help the local people?", most respondents listed various problems.

As a possible solution to the lack of water, they requested deep wells and washouses (30%). Second, 15% appealed requested basic resources such as food, medicine, school supplies, work and mills to transform the fruits. Finally, they suggested education as another solution (19%).

In addition, 45% said they did not know the solutions and that others had to solve the problems. However, 87% of respondents had a positive attitude, collaborative, and were supporters of chimpanzee conservation.

3.3. Associations between characteristics of the local population and chimpanzee conservation.

The results presented in Tables 3, 4 and 5 show the relationships existing between education, the Trees for the Future project and animist beliefs with the most representative questions of chimpanzee conservation questions.

Table 3 shows associations between education and some questions of chimpanzee conservation, with one significant relationship between education and some chimpanzee conservation questions (Table 3).

Table 4 presents associations between the Trees for the Future project and some questions of chimpanzee conservation. These results show four significant relationships between the project and the local perception of the conservation of chimpanzees.

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Finally, Table 5 shows associations between Animism and some questions of chimpanzee conservation. Eleven significant associations between animism and items related to the conservation of primates were found.

4. Discussion

4.1. Characteristics of the local population

The characteristics of the studied population coincide with those of other studies of local perceptions on chimpanzee conservation in other African countries. They are local groups with low life expectancies, subsistence economies, high population growth rates, low participation in basic education, and traditional beliefs with implications for biodiversity conservation. Gambia, Togo, Benin and Burkina Faso are countries that stand out because chimpanzees are already extinct there and, as a result, may be examples that provide clues to prevent the same thing from happening in other countries like Senegal and Ghana, where there are very few chimpanzees left. These countries share high human population densities [29]. There is an estimated world population increase from 7 billion in 2012 to 9 billion in 2050, where the highest growth is in tropical nations. Today, 2 billion people live in regions where primate species live, and are characterized by high levels of poverty. This growth increases the demand of the markets, which affects crops, wood, minerals and oil that come from zones of primates. This increases deforestation and habitat fragmentation and, thus, the decline of the primate population. In turn, poverty in these regions increases. It is the current conservation challenge [41].

Senegal is among the poorest countries in the world, as are also Guinea Bissau and Burkina Faso. In Burkina, around 90% of the population depends on subsistence agriculture. In Senegal, the economy is mainly based on agriculture (especially peanuts), fishing and tourism. Most of these countries live below the poverty level, where less than 40% of the population has access to health service, potable water and sanitation [29]. Senegal also shares with other African countries the performance of several international NGOs with cooperation projects, which help people in health care, education and the environment, among others.

These African countries have many ethnic groups with different cultures and traditional beliefs, such as animism in the RNCD of the Peul ethnic group, like the Nalu and Balanta in Guinea-Bissau [26,11], 60 ethnic groups in The Ivory Coast [29] or the Malika people in Mali [35].

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4.2. Conservation of chimpanzees

Local people are afraid of chimpanzees because they think they attack. If a person finds a chimpanzee in the forest, he stops, observes, and if the chimp moves away, the person continues with his activity, but if they see something strange in the chimpanzee, local people run towards the village. The knowledge of these three psychological variables (emotions, thoughts and behaviors) would allow researchers to design a specific program to work on the distorted beliefs of the local population. These local perceptions towards chimpanzees in Senegal coincide with those of other countries such as Uganda [9,17] and Guinea Bissau [6,42,20]. In the RNCD, just as in Uganda, the locals see more chimpanzees currently, which could be a sign of habitat fragmentation [9]. In several investigations it has been found that locals were supporters of chimpanzee conservation as long as they lived in the woods and the population could benefit from them, i.e., crop protection against other animals, work, projects or ecotourism. On the contrary, if chimpanzees entered their towns, competed for natural resources (fruits, crops, water, etc.), attacked humans, or were a source of food or money for illegal trafficking, local perception would change and locals would kill them [6,9,42,43]. In Dindéfélo, some respondents commented that if the chimpanzees entered the village, there would be a problem.

Water is a resource which humans and wildlife compete for in southeastern Senegal and northern Guinea [28,29]. In the RNCD, there were conflicts between humans and chimpanzees for water [10] because they struggled to obtain it at the same time and in the same place, especially during the dry season, which caused stress to both parties. In the RNCD, locals used the river as their washing place because there was plenty of water and they found it easier to wash themselves there. Also, they did not use deep wells because they had to wait for their turn and the water was hard to extract. This meant that, in addition to using the river as a toilet and shower, they left the soap plastic containers in the forest as well as their worn clothing. As a result of this, a possible source of contamination and zoonosis would be created. Cows and baboons were also observed eating the abandoned clothes and, afterwards, found their dead bodies with clothes inside (personal observations). Aside from this, the problem of garbage in the Reserve has not been completely solved through an American project with wastebaskets. The garbage of wastebaskets was later burnt. Local people did not want their clothes to be burnt. They had the animistic belief that if the clothes were burnt, this could make many people from the community become ill.

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So, it is important to consider this animist belief to solve the problem. An awareness program could be carried out, work on these beliefs and create a recycling project that included old clothes and plastics to provide local people with work. Also, out of the new extracted material, new fabrics and affordable local clothing could be made.

Most locals remembered the existence of more trees 30 years ago, as also happens in Uganda. However, others thought that there were not any problems of deforestation, which coincides with local opinions in Uganda and Guinea-Bissau about the fact that the forest will last forever (77%), or that the forest will not run out of resources (38%) [26,30,9,43]. This was the reason why locals complained about bans in the Reserve against cutting and burning down trees. In addition, they claim that they are poor and need forest resources to live on.

It is worth noting that in the RNCD chimpanzees did not feed crops, which contrasts with the vast majority of research in other countries, such as Uganda [9] and Guinea-Bissau [44,6,45,8]. The expansion of agriculture is one of the main causes of deforestation and the extinction of species such as chimpanzees [29] as in Mali [35], Guinea-Bissau [6,8], Gambia, Republic of Guinea, Sierra Leone, The Ivory Coast, Ghana, Benin, Burkina Faso and Nigeria [29]. So, this matter would require further studies to investigate the variables that influence the situation of the RNCD for chimpanzees who live in human-dominated landscapes but do not feed from the fields, to help with this problem in other countries.

As in Guinea-Bissau and Uganda, baboons in the RNCD were perceived to be more harmful than were chimpanzees in crops [6,9,43] and fruits of the forest [29,43]. Locals commented that “chimpanzees only took what they needed” [17]. However, there was a competition for fruits, such as *S. senegalensis,* because human extraction was in large quantities for national trade [29,10,38]. Fires were recurrent every year in every village of the Reserve mainly to open up more croplands. Also, in the RNCD honey was barely stolen by chimpanzees, unlike in Uganda [9].

The fundamental problem in the RNCD is the lack of water. At the end of 2015, in Dindéfélo, drilling for water was carried out in order to extract and supply water to several villages through taps. The drilling was done by the government in a highly protected area of the reserve, up to 40 meters down, in an important area of chimpanzees. If the drilling had taken place in an area outside the reserve, it would have been an excellent project for the local population and would also have benefitted the biodiversity of the Reserve. If taps worked, it would not be necessary to improve the public laundry built by the IJGE. In Segou and Nandoumary, it would be necessary

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to build deeper water wells, facilitate their access, and build public laundries (large, centrally located and with plenty of water).

The locals proposed solutions like wells, washhouses, basic resources (food, medicines, school supplies, among others) and education. Through IJGE projects for the establishment of nature reserves, research and monitoring of the primate population, local job creation, promotion of local management, green fences, nurseries, recovery of natural corridors, projects for women, among others, it is intended to combat the extinction of chimpanzees and provide basic resources to the local population in the RNCD. Also, it is important to develop educational projects, raise awareness of the conservation of chimpanzees, the expansion of protected areas, promote zoning (for humans and for wildlife), and of the promotion of co-management for the conservation among local people, governmental and non-governmental organizations. Furthermore, it is worth considering such issues as bioconstruction, sustainable development, family planning, sustainable farming systems, education for women, promoting positive attitudes toward chimpanzees, fire prevention, recovery of the fruit orchards, reinforcements for sustainable towns like Segou, urgent projects for Nandoumary (sustainable agriculture, reforestation, water wells and laundries, among others), medical and health support and solar panels, among others. The characteristics of the population require measures for the management of conservation with short-term benefits and low-cost local efforts. It would also be necessary to bring the law closer to this remote area with Agent des Eaux et Forêts, which supported the role of Eco-guards in the Reserve, as in Guinea-Bissau [11].

Dindéfélo is a village near the mountains, so human presence is very close to the forest every day, and it also has a great tourist attraction for its natural waterfall. It would be essential to control the massive influx of people into the forest with ecotourism and trained and certified local staff because tourism with wildlife, when humans are so close, can be dangerous to both [46,11,8,47,48,9,49,42].

4.3. Influences of education, Trees for the Future project and animist beliefs about the perception of chimpanzee conservation.

Locals who had not received elementary education thought, to a greater extent, that chimpanzees do not attack as opposed to those who had gone to school. This could be explained because if local knowledge is based only on the experience of the vast majority of the times they go to the forest, chimpanzees do not attack them. In

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some research, it has been found that basic education is another variable that influences the local perception of conservation, as well as gender, age, status, lineage, access to land, power, wealth [11,25]. Gadd found in Kenya that locals without elementary education were more open to wildlife tourism and conservation programs because their situation improved. Estrada postulates that multiple solutions are needed for the global problem of species extinction. A master formula is to transform conservation into benefits for the locals and also defray their needs, such as food security, health or education [2,55,58].

In Zimbabwe, researchers have found that the locals did not know the protected area well despite having lived there for years. Education and awareness programs are necessary for people to be aware of conservation and wildlife projects. These programs could change local perceptions and increase participation in conservation management [50]. This coincides with our findings that locals who were not participating in Trees for the Future project argued that there were practically no fires in the last year in the RNCD, as compared to those who were participating in the project. In the same way in The Ivory Coast, child environmental education projects have increased environmental awareness and positively influenced attitudes towards nature [51]. In the Congo, they observed a relationship between poverty and lack of conservation of wildlife because they killed animals to eat them. In this way, they gave economic incentives to children attending educational conservation projects, among other measures. This approach helped to reduce poaching of protected species, which led to the more sustainable amount of wildlife in the Congo [52].

Several studies have found influences of religion on conservation of biodiversity. In Guinea-Bissau, Muslims tend to plant fruit trees, so primates are bad because they eat these fruits. Non-Muslims, on the other hand, grow rice, which is less attractive to chimpanzees, so chimpanzees are not perceived as bad. A relationship has been found between the Muslims and anthropo-centrism. Some local communities find similarities between chimpanzees and humans, which favors positive attitudes toward chimpanzees because, if they could not be human and had to choose between the animal kingdom species, they would choose to be chimpanzees [26,11,6].

The widespread traditional belief that if the clothes are burned, the community will become seriously ill would explain that the clothes are hung in the trees in the forest because, in case of a fire, that would not burn. These clothes are eaten by cows and baboons in the forest. Dead animal bodies have been found with clothes inside of them. A wastebasket project to solve the garbage problem was not being effective

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concerning clothes for this reason. As for baobabs, for example, in Dindéfélo they are practically not seen, and the few that are left are felled, which would be related to the animistic idea that if there are many baobabs *(Adansonia digitata)* together they attract the devil. Nevertheless, the belief that if felled in the area of the devil, you would become ill. Our results show relationships between animism and fear of chimpanzees by thinking that chimpanzees attack. The Peul tell stories about chimpanzees that kill human babies or that if one encounters them in the forest, afterwards they will find a dead family member at home. That a human baby behaves like a chimp for the Peul is a bad thing. Stories are related to bad luck, the devil, traditional medicine, healing, among others. It could relate in some ways to African sorcery, as in Sierra Leone, where the people say that witches dress like chimpanzees, so body parts are used for rituals and acquire magical powers [13,53,20]. In Madagascar, the belief in bad luck also exists together with bad omens about future disaster, yet they just see some particular species of primates (*Daubentonia madagascariensis*) as the messengers of the devil, so that they believe it is necessary to kill them [54]. Other ancestral beliefs can favor the killing of chimpanzees, as in Ghana, Nigeria and Togo it is for meat [29]. On other occasions, chimpanzees are killed for medical purposes because of the belief in devils living inside of these animals [17]. In Mali, locals do not eat meat, but the Maninka people use it as traditional medicine [35], as in Guinea-Bissau [42]. In the RNCD, they use the Patas monkey *(Erythrocebus patas)* meat to cure diseases or infertility. With respect to chimpanzees, animist stories translate into fear of chimpanzees and, for now, of respect.

However this negative perception of chimpanzees in Dindéfélo and Nandoumary is different in Segou, because they say that chimpanzees are good because they are like humans and, as a consequence, show a positive attitude toward chimpanzee conservation. In Guinea-Bissau and Uganda, locals do not eat chimpanzees because they see them as being humanlike [6,15,29,42,60]. This point of view of chimpanzees being like humans makes a big difference in local perception because it contributes to enhance tolerance, better co-existence, and support for chimpanzee conservation [43]. Locals from Guinea Bissau said that chimpanzees had been men who were punished by God for being lazy or fishing on banned days [42] is the same idea as in the RNCD. Another story found by Sousa is that the chimpanzee was a blacksmith transformed into a bush by God [20]. In Uganda the idea that chimpanzees only eat what they need makes these primates more human for certain local communities. There are even communities that convert them into flagships or totems. In The Ivory Coast, people do not kill chimpanzees because they are their

totem, or in Uganda the chimpanzees are not eaten out of tradition. However, if locals believe that primates are transgressing social rules such as crop raiding or attacks on humans, such positive attitudes become negative and people can kill them [15].

This is the problem of the age of the Anthropocene with human population growth, greater demand for markets, expansion of agriculture, fragmentation of habitats, crops feeding and conflicts with local people. Thanks to knowledge of local perceptions and attitudes, we believe that the solution for the RNCD is the zoning and expansion of protected areas rather than promoting human-chimp co-existence [14]. Thus, humans would have their area for crops and helps with programs to improve sustainable agriculture and wildlife would have their habitat and the natural resources that the locals need to add to their area with washhouses and orchards. Family planning and the search for a sustainable balance are also very important. According to Estrada, several investigations on local perceptions and conservation agree on the importance of considering them because they improve the effectiveness to achieve a sustainable coexistence in this complex period of the Anthropocene [2,56,59,61-63].

5. Conclusions

In conclusion, in one of the poorest areas of Senegal there are ethnic groups with religion and animist beliefs that have an influence on biodiversity conservation. Fear of chimpanzees translates into a fragile respect that can be broken at any time and become a greater threat to these primates. There are conflicts over basic resources (water and trees) in the RNCD. There were significant correlations between local perceptions and education, the environmental project and animism. Local perceptions allow us to design a specific course of action to improve chimpanzee conservation and sustainable coexistence in this complex period of the Anthropocene.

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References

1. Gibson, L.; Lee, T.M.; Koh, L.P.; Brook, B.W.; Gardner, T.A.; Barlow, J.; Peres, C.A.; Bradshaw, C.J.A.; Laurance, W.F.; Lovejoy, T.E.; Sodhi, N.S. Primary forests are irreplaceable for sustaining tropical biodiversity *Nature* 2011, 478, 378–381.
2. Estrada, A.; Garber, P.A.; Rylands, A.B.; Roos, C.; Fernandez-Duque, E.; Di Fiore, A.; Nekaris, K.; Nijman, V.; Heymann, E.W.; Lambert, J.E.; Rovero, F.; Barelli, C.; Setchell, J.M.; Gillespie, T.R.; Mittermeier, R.A.; Arregoitia, L.V.; de Guinea, M.; Dobrovolski, S.R.; Shanee, S.; Shanee, N.; Boyle, S.A.; Fuentes, A.; MacKinnon, K.C.; Amato, K.R.; Meyer, A.L.S.; Wich, S.; Sussman, R.W.; Pan, R.; Kone, I.; Li, B. Impending extinction crisis of the world's primates: Why primates matter. *Sci. Adv*. 2017. 3, e1600946.
3. Thomas, J.A.; Telfer, M.G.; Roy, D.B.; Preston, C.D.; Greenwood, J.J.; Asher, J.; Fox, R.; Clarke, R.T.; Lawton, J.H. Comparative losses of British butterflies, birds, and plants and the global extinction crisis. *Science*. 2004. 303, 1879–1881. doi:10.1126/science.1095046.
4. Campbell-Smith, G.; Simanjorang, H.V.P.; Leader-Williams, N.; Linkie, M. Local attitudes and perceptions toward crop-raiding by orangutans *(Pongo abelii)* and other nonhuman primates in Northern Sumatra, Indonesia. *Am. J. Primatol*. 2010. 72, 866–876. doi:10.1002/ajp.20822.
5. Conforti, V. A.; Azevedo, F.C. Local perceptions of jaguars *(Panthera onca)* and pumas *(Puma concolor)* in the Iguacu National Park area , south Brazil. *Biological Conservation*. 2003. 111, 215–221. doi:10.1016/S0006-3207(02)00277-X.
6. Costa, S.; Casanova, C.; Sousa, C.; Lee, P. The Good, The Bad and The Ugly: Perceptions of Wildlife In Tombali (Guinea-Bissau, West Africa). *J. Primatol.* 2013. 2:1. http://dx.doi.org/10.4172/2167-6801.1000110
7. Fernández-Llamazares, Á.; Gueze, M.; Cabeza, M.; Reyes-García, V. Local perceptions as a guide for the sustainable management of natural resources: Empirical evidence from a small-scale society in Bolivian Amazonia. *Ecol. Soc*.

575 2016.21. doi:10.5751/ES-08092-210102.
576 8. Hockings, K.J.; Sousa, C. Human-Chimpanzee Sympatry and Interactions in
577 Cantanhez National Park, Guinea-Bissau: Current Research and Future
578 Directions. *Primate Conserv*. 2013. 26, 57–65. doi:10.1896/052.026.0104.
579 9. McLennan, M.R.; Hill, C.M. Troublesome neighbours: Changing attitudes
580 towards chimpanzees (Pan troglodytes) in a human-dominated landscape in
581 Uganda. *J. Nat. Conserv*. 2012. 20, 219–227. doi:10.1016/j.jnc.2012.03.002.
582 10. Pacheco, L.; Fraixedas, S.; Fernández-Llamazares, Á.; Estela, N.; Mominee,
583 R.; Guallar, F. Perspectives on sustainable resource conservation in community
584 nature reserves: A case study from Senegal. *Sustainability*. 2012. 4, 3158–
585 3179. doi:10.3390/su4113158.
586 11. Costa, S. Social perceptions of Nonhumans in Tombali (Guinea-Bissau, West
587 Africa): a contribution to chimpazee *(Pan troglodytes verus)* conservation.
588 Thesis. University of Stirling. 2010.
589 12. Pérez-Acosta, A.M.; Sánchez, A.R.; Vargas, M.C. Albert Ellis (1913-2007):
590 Pionero de los modelos mediacionales de intervención. *Behavioral Psychology*.
591 2008. 16, 2, 341–348.
592 13. Hill, C.M. Perspectives of “Conflict” at the Wildlife–Agriculture Boundary: 10
593 Years On. *Human Dimensions of Wildlife: An International Journal*. 2015.
594 DOI:10.1080/10871209.2015.1004143.
595 14. Hill, C.M. Primate Crop Feeding Behavior, Crop Protection, and Conservation.
596 *International Journal of Primatology*. 2017. DOI 10.1007/s10764-017-9951-3.
597 15. Hill, C.M.; Webber, A.D. Perceptions of nonhuman primates in human-wildlife
598 conflict scenarios. *Am. J. Primatol*. 2010. 72, 919–924. doi:10.1002/ajp.20845.
599 16. McLennan, M.R.; Spagnoletti, N. and Hockings, K.J. The Implications of
600 Primate Behavioral Flexibility for Sustainable Human Primate Coexistence in
601 Anthroponcenic Habitats. *IntJPrimatol*. 2017. 38:105–121. DOI10.1007/s10764-
602 017-9962-0.
603 17. Webber, A.D. and Hill, C.M. Using Participatory Risk Mapping (PRM) to identify
604 and understand people’s perceptions of crop loss to animals in Uganda. *PLoS*
605 *One*. 2014. 9(7). doi:10.1371/journal.pone.0102912.
606 18. Hockings, K.J. and Sousa, C. Human-Chimpanzee Sympatry and Interactions
607 in Cantanhez National Park, Guinea-Bissau: Current Research and Future
608 Directions. *Primate Conservation*, 2013, 26(1):57-65. DOI:
609 http://dx.doi.org/10.1896/052.026.0104.
610 19. Hockings, K.J.; McLennan, M.R.; Carvalho, S.; Ancrenaz, M.; Bobe, R.; Byrne,
611 R.W.; Dunbar, R.I.M.; Matsuzawa, T.; McGrew, W.C.; Williamson, E.A.; Wilson,

M.L.; Wood, B.; Wrangham, R.W. and Hill, C.M. Apes in the Anthropocene: flexibility and survival. *Trends in Ecology & Evolution*. 2015. DOI: 10.1016/j.tree.2015.02.002.

20. Sousa, J.; Ainslie, A.; Hill, C.M. Sorcery and nature conservation. *Environmental Conservation*. 2017. 1-6. DOI: 10.1017/S0376892917000327.
21. Torres, J.; Brito, J,C.; Vasconcelos, M.J.; Catarino, L.; Gonçalves, J.; Honrado, J. Ensemble models of habitat suitability relate chimpanzee *(Pan troglodytes)* conservation to forest and landscape dynamics in Western Africa. *Biological Conservation.* 2010. 143. 416–425.
22. Setchell, J.M.; Fairet, E.; Shutt, K.; Waters, S.; Bell, S. Biosocial Conservation: Integrating Biological and Ethnographic Methods to Study Human–Primate Interactions. *Int J Primatol*. 2017. 38:401–426. DOI 10.1007/s10764-016-9938-5.
23. Fuentes, A. Ethnoprimatology and the Anthropology of the Human-Primate Interface. *Annu. Rev. Anthropol*. 2012. 41:101–17.
24. Hill, C.M. Conflict of Interest Between People and Baboons: Crop Raiding in Uganda. *International Journal of Primatology*, 2000, Vol. 21, No. 2.
25. Gadd, M. Conservation outside of parks: attitudes of local people in Laikipia, Kenya. *Environmental Conservation*, 2005, 32(1): 50-63.
26. Casanova, C.; Sousa C. and Costa, S. Are animals and forests forever? Perceptions of wildlife at Cantanhez Forest National Park, Guinea-Bissau Republic, Memórias. *Environmental Anthropology*,2014, 16:69-104.
27. Humle, T.; Maisels, F.; Oates, J.F.; Plumptre, A. and Williamson, E.A. 2016. Pan troglodytes. The IUCN Red List of Threatened Species 2016: e.T15933A17964454. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T15933A17964454.en
28. Hockings, K.; Humle, T. 2009. Best Practice Guidelines for the Prevention and Mitigation of Conflict Between Humans and Great Apes, Survival. IUCN/SSC, Primate Specialist Group. doi:10.2305/IUCN.CH.2009.SSC-OP.37.en
29. Kormos, R.; Boesch, C.; Bakarr, M.I. and Butynski, T. (eds.). (2003). West African Chimpanzees. Status Survey and Conservation Action Plan. IUCN/SSC Primate Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. ix + 219 pp.
30. McLennan, M.R. Beleaguered Chimpanzees in the Agricultural District of Hoima, Western Uganda. *Primate Conserv.* 2008. 23, 45–54. doi:10.1896/052.023.0105

31. Michalski F, Peres CA. Anthropogenic determinants of primate and carnivore local extinctions in a fragmented forest landscape of southern Amazonia. Biological Conservation. 2005. 124. 383–396.
32. Pruetz, J.; Bertolani, P. Chimpanzee (Pan troglodytes verus) Behavioral Responses to Stresses Associated with Living in a Savannah-Mosaic Environment: Implications for Hominin Adaptations to Open Habitats. *PaleoAnthropology*, 2009, 252–262. doi:10.4207/PA.2009.ART33
33. Tappan, G.G.; Sall, M.; Wood, E.C.; Cushing, M. Ecoregions and land cover trends in Senegal. *J. Arid Environ.* 2004. 59, 427–462. doi:10.1016/j.jaridenv.2004.03.018
34. Wood, E.C.; Tappan, G.G.; Hadj, A. Understanding the drivers of agricultural land use change in south-central Senegal. *J. Arid Environ*. 2004. 59, 565–582. doi:10.1016/j.jaridenv.2004.03.022
35. Duvall, C.S. Human settlement ecology and chimpanzee habitat selection in Mali. *Landsc. Ecol*. 2008. 23, 699–716. doi:10.1007/s10980-008-9231-x
36. Pruetz, J.D. Studying Apes in a Human Landscape. In: Primate Ethnographies. K. Strier, Ed. Pearson Publishers. 2013. ISBN.
37. Norconk, M.A.; Boinski, S.; Forget, P.M. Primates in 21st century ecosystems: Does primate conservation promote ecosystem conservation? *Am. J. Primatol*. 2011. 73, 3–8.
38. Waller, M.T.; Pruetz, J. Competition Between Chimpanzees and Humans : The Effects of Harvesting Non- timber Forest Products. *Ethnoprimatology* 2016 157–177. doi:10.1007/978-3-319-30469-4
39. Muñoz, P.; Rodriguez, X.; Diallo, A.G. Estudio socio-económico. Comunidad Rural de Dindéfélo (CRD). Región de Kédougou-Senegal. 2014. (Unpublished).
40. Pacheco, L.; Azua, N.R.; Fernández-García, J.M.; Aransay, N.; Guallar, F. and Gaubert, P. First record of Johnston's Genet Genetta johnstoni in Senegal. *Small Carnivore conservation*. 2013. 48, 89–91.
41. Estrada, A. Human Population Growth, Poverty. In *The International Encyclopedia of Primatology*. 2017. 1–6. ISBN.
42. Sousa, J.; Vicente, L.; Gippoliti, S.; Casanova, C. Local knowledge and perceptions of chimpanzees in Cantanhez National Park, Guinea-Bissau. *Am. J. Primatol*. 2014. 76, 122–134. doi:10.1002/ajp.22215
43. Watkins, C.A. Natural resource use strategies in a forest-adjacent Ugandan village. *Hum. Ecol.* 2009. 37, 723–731. doi:10.1007/s10745-009-9268-8
44. Bessa, J.; Sousa, C.; Hockings, K.J. Feeding ecology of chimpanzees *(Pan troglodytes verus)* inhabiting a forest-mangrove-savanna-agricultural matrix at

685 Caiquene-Cadique, Cantanhez National Park, Guinea-Bissau. *Am. J. Primatol*.
686 2015. 77, 651–665. doi:10.1002/ajp.22388
687 45. Hockings, K.J. Human-chimpanzee coexistence at Bossou , the Republic of
688 Guinea : A chimpanzee perspective. A thesis submitted for the degree of
689 Department of Psychology. 2007. 1–272.
690 46. Adams, W.M.; Infield, M. Who is on the Gorilla's payroll? Claims on tourist
691 revenue from a Ugandan National Park. *World Dev.* 2003. 31, 177–190.
692 47. Horowitz, L.S. Integrating indigenous resource management with wildlife
693 conservation: a case study of Batang Ai National Park, Sarawak, Malaysia.
694 *Hum. Ecol.* 1998. 26, 371–403.
695 48. Laudati, A. Ecotourism: The modern predator? i/Implications of gorilla tourism
696 on local livelihoods in Bwindi impenetrable national park, Uganda. *Environ.*
697 *Plan. D Soc. Sp.* 2010. 28, 726–743.
698 49. Okello, M.M. Land Use Changes and Human–Wildlife Conflicts in the Amboseli
699 Area, Kenya. *Hum. Dimens. Wildl.* 2005. 10, 19–28.
700 doi:10.1080/10871200590904851
701 50. Gandiwa, E.; Zisadza-gandiwa, P.; Muboko, N.; Libombo, E. Local People's
702 Knowledge and Perceptions of Wildlife Conservation in Southeastern
703 Zimbabwe. *J. Environ. Prot.* 2014. (Irvine,. Calif). 475–481.
704 51. Borchers, C.; Boesch, C.; Riedel, J.; Guilahoux, H.; Ouattara, D.; Randler, C.
705 Environmental Education in Côte d'Ivoire/West Africa: Extra-Curricular Primary
706 School Teaching Shows Positive Impact on Environmental Knowledge and
707 Attitudes. *Int. J. Sci. Educ.* 2014. Part B 4, 240–259.
708 doi:10.1080/21548455.2013.803632
709 52. Breuer, T. and Mavinga, F.B. Education for the Conservation of Great Apes and
710 Other Wildlife in Northern Congo—the Importance of Nature Clubs. *American*
711 *Journal of Primatology* 2009 71:1–8
712 53. Richards, P. (2000) Chimpanzees as political animals in Sierra Leone. In:
713 *Natural Enemies: People–Wildlife Conflicts in Anthropological Perspective*, ed.
714 J. Knight. London, UK: European Association of Social Anthropologists. 2000.
715 pp. 78–103. ISBN.
716 54. Baker, L. Links between local folklore and the conservation of Sclater's monkey
717 *(Cercopithecus sclateri)* in Nigeria. *Afr Primates* 2013 8, 17–24.
718 55. Ayivor, J.S.; Gordon, C.; Ntiamoa-baidu, Y. Protected Area Management and
719 Livelihood Conflicts in Ghana : a Case Study of Digya National Park. *Parks*
720 2013. 19, 37–50.

721 56. Brooks, T.M.; Mittermeier, R.A.; Fonseca, G.A.B.; Gerlach, J.; Hoffmann, M.;
722 Lamoreux, J.F.; Mittermeier, C.G.; Pilgrim, J.D.; Rodrigues, A.S.L. Global
723 Biodiversity Conservation Priorities. *Science* 2006. 80. 313, 58–61.
724 doi:10.1126/science.1127609
725 57. Etiendem, D.N.; Hens, L.; Pereboom, Z. Traditional knowledge systems and the
726 conservation of cross river gorillas: A case study of Bechati, Fossimondi, Besali,
727 *Cameroon. Ecol. Soc.* 2011 16, 6.
728 58. Gillingham, S.; Lee, P.C. The impact of wildlife-related benefits on the
729 conservation attitudes of local people around the Selous Game Reserve,
730 Tanzania. *Environ. Conserv.* 1999. 26, 218–228.
731 59. Junker, J.; Blake, S.; Boesch, C.; Campbell, G.; Toit, L. du; Duvall, C., Ekobo,
732 A.; Etoga, G.; Galat-Luong, A.; Gamys, J.; Ganas-Swaray, J.; Gatti, S.;
733 Ghiurghi, A.; Granier, N.; Hart, J.; Head, J.; Herbinger, I.; Hicks, T.C.;
734 Huijbregts, B.; Imong, I.S.; Kuempel, N.; Lahm, S.; Lindsell, J.; Maisels, F.;
735 McLennan, M.; Martinez, L.; Morgan, B.; Morgan, D.; Mulindahabi, F.; Mundry,
736 R.; N'Goran, K.P.; Normand, E.; Ntongho, A.; Okon, D.T.; Petre, C.A.;
737 Plumptre, A.; Rainey, H.; Regnaut, S.; Sanz, C.; Stokes, E.; Tondossama, A.;
738 Tranquilli, S.; Sunderland-Groves, J.; Walsh, P.; Warren, Y.; Williamson, E.A.;
739 Kuehl, H.S. Recent decline in suitable environmental conditions for African
740 great apes. *Divers. Distrib*. 2012. 18, 1077–1091. doi:10.1111/ddi.12005
741 60. McLennan, M.R. Chimpanzee Ecology and Interactions with People in an
742 Unprotected Human-Dominated Landscape at Bulindi, Western Uganda. Thesis
743 Department of Anthropology & Geography. Oxford Brookes University. 2010.
744 61. Michalski, F.; Peres, C.A. Anthropogenic determinants of primate and carnivore
745 local extinctions in a fragmented forest landscape of southern Amazonia. *Biol.*
746 *Conserv.* 2005. 124, 383–396. doi:10.1016/j.biocon.2005.01.045
747 62. Rust, N.A.; Abramsb, A.; Challenderc, D.; Chaprond, G.; Ghoddousie, A.;
748 Glikmanf, J.A.; Gowang, C.H.; Hughesh, C.; Rastogii, A.; Saidc, A.; Suttonj, A.;
749 Taylork, N.; Thomasl, S.; Unnikrishnanm, H.; Webbern, A,D.; Wordinghamo, G.;
750 Hill, C.M. Quantity Does Not Always Mean Quality: The Importance of
751 Qualitative Social Science in Conservation Research. *Society & Natural*
752 *Resources.* 2017. https://doi.org/10.1080/08941920.2017.1333661
753 63. Vodouhê, F.G.; Coulibaly, O.; Adégbidi, A.; Sinsin, B. Community perception of
754 biodiversity conservation within protected areas in Benin. *For. Policy Econ.*
755 2010. 12, 505–512. doi:10.1016/j.forpol.2010.06.008

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Appendices

1. If a pregnant woman saw a chimpanzee, would the baby behave like a chimpanzee?	Yes 48.25% n=165	No 46.75% n=158	Unsure 4.44% n= 15
2. If you log in the devil´s area, would it make you sick?	Yes 89.05% n=301	No 8.28% n=28	Unsure 2.66% n=9
3. If the old clothes were burnt, would children become sick?	Yes 91.42% n=309	No 7.69% n=26	Unsure 0.89% n= 3
4. If you throw stones at animals, it would hurt your arm?	Yes 64.50% n=218	No 30.18% n=102	Unsure 5.33% n=18
5. Is eating Patas monkey *(Erythrocebus patas)* meat good to curing disease "inflammation" and help women who cannot have children?	Yes 49.70% n=168	No 43.20% n=146	Unsure 7.10% n=24
6. Do many baobabs together attract the devil?	Yes 52.37% n=177	No 14.20% n=48	Unsure 33.43% n=113

Table A.1. Description of some animistic beliefs of the Peul ethnic group in the RNCD (Senegal) studied.

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CATEGORY	QUESTIONS	ANSWERS			
CHIMPANZEES	1. What do you do when you see a chimp?	Continue 63.02% n=213	Run 36.39% n=123	Unsure 0.59% n= 2	Others --
	2. What do you feel when you see a chimp?	Calm 45.56% n=154	Afraid 53.85% n= 182	Unsure 0.59% n= 2	Others --
	3. Why are people afraid of chimpanzees?	Attack 67.75% n= 229	Don´t attack 26.33% n=89	Unsure 5.92% n=20	Others --
	4. When did you see chimps?	Dry season 44.38% n= 150	Rainy season 29.59% n=100	Unsure 26.04% n= 88	Others --
	5. Do you know people who have been attacked by chimpanzees?	Yes 11.83% n= 40	No 87.87% n=297	Unsure 0.30% n=1	Others --
WATER	6. Why do you wash clothes in the river?	More water 77.51% n=262	There is nowhere else 21.89% n= 74	Unsure 0.59% n= 2	Others --
	7. Why do you have to throw the old clothes in the forest?	Tradition 50.30% n= 170	There is nowhere else 35.80% n= 121	Doesn´t do it 4.44% n=15	Unsure 9.47% n=32
TREES	8.Thirty years ago, were there more trees in town?	Yes 71.89% n=243	No 14.79% n=50	Unsure 13.31% n=45	Others --
	9. Do chimpanzees eat crops in the fields?	Yes 3.25% n= 11	No 95.86% n=324	Unsure 0.89% n= 3	Others --
	10. When you go to pick fruits of the forestor not, is it because chimpanzees have eaten them?	Yes 26.04% n=88	No 71.30% n=241	Unsure 2.66% n=9	Others --
	11. How many forest fires have there been in the last year?	0 fires 2.96% n= 10	1 fire 33.73% n=114	2 o more fires 39.05% n=132	Others --
	12. Have chimpanzees stolen honey from your hives?	Yes 25.15% n= 85	No 66.75% n=225	Unsure 8.28% n= 28	Others --
	13. Would you like to protect livestock within a fence all year round?	Yes 89.69% n= 294	No 8.92% n=38	Unsure 1.38% n= 6	Others --

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PROBLEMS AND SOLUTIONS	14. How can the Reserve help the people? (Problems)	1º problem: water 34.91% n=118	2º problem: resources 17.16% n=58	3º problem: felling 15.38% n=52	No problem 32.21% n=110
	15. And how can you get them? (Solutions)	1º solution: wells 30.18% n=102	2º solution: resources 15.09% n=51	3º solution: education 19.31% n=113	Unsure 45.27% n=72

Table A.2. Questions of the interview about chimpanzee conservation.

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CATEGORIES	INTERVIEW QUESTIONS		EDUCATION	
		SCHOOL	HIGH SCHOOL	NO SCHOOL
		%	%	%
CHIMPANZEES	2. What do you feel when you see a chimp?			
	Calm	29.2	10.3	42.2
	Fear	29.6	11.5	42.3
		$\chi^2 = 0.08$, P = 0.96		
	3. Why are people afraid of chimpanzees?			
	Attack	33.6	10.4	34.9
	Don´t attack	14.6	12.3	65.1
		$\chi^2 = 19.32$, P < 0.0001		
WATER	6. Why do you wash clothes in the river?			
	More water	28.6	11.8	45
	There is nowhere else	31	6.7	35.1
		$\chi^2 = 1.90$, P = 0.39		
	7. Why you have to throw the old forest clothes?			
	Habit	25.8	11.7	42.3
	Nowhere	27.2	12.4	50.4
	Doesn´t do it	33.3	0	53.3
		$\chi^2 = 2.39$, P = 0.66		
TREES	8. Thirty years ago, were there more trees in town?			
	Yes	27.9	11.1	42.3
	No	32	10	48
		$\chi^2 = 0.20$, P = 0.90		
	11. How many forest fires had in the last year?			
	0 fires	20	10	60
	1 fire	35	10.5	8.6
	2 o more fires	21.9	11.3	50
		$\chi^2 = 6.23$, P = 0.18		

793

794 **Table A.3.** Associations between education and some questions of chimpanzee
795 conservation.

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798

CATEGORIES	INTERVIEW QUESTIONS	TREES FOR THE FUTURE PROJECT	
		YES %	NO %
CHIMPANZEES	2. What do you feel when you see a chimp? Calm	19.5	69.5
	Fear	11.5	81.9
		$\chi^2 = 4.98$, $P < 0.0255$	
	3. Why are people afraid of chimpanzees? Attack	8.7	86.4
	Don´t attack	33.7	47.1
		$\chi^2 = 40.05$, $P < 0.0001$	
WATER	6. Why do you wash clothes in the river? More water	14.8	75.1
	There is nowhere else	14.8	81.1
		$\chi^2 = 0.04$, $P = 0.84$	
	7. Why do you have to throw the old clothes in the forest? Habit	17.6	70.5
	Nowhere else	14	78.5
	Doesn´t do it	13.3	86.6
		$\chi^2 = 1.23$, $P = 0.54$	
TREES	8.-Thirty years ago, were there more trees in town? Yes	17.7	71.6
	No	4	90
		$\chi^2 = 6.61$, $P < 0.0101$	
	11. How many forest fires have there been in the last year? 0 fires	10	90
	1 fire	11.4	82.4
	2 o more fires	24.2	62.8
		$\chi^2 = 9.20$, $P < 0.0100$	

799

800 **Table A.4.** Associations between Trees for the Future Project and some questions of
801 chimpanzee conservation.

802

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INTERVIEW QUESTIONS	ANIMISM											
	BABY CHIMP		DEVIL'S AREA		CLOTHES BURNED		STONE ANIMALS		MONKEY MEAT		BAOBABS	
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
	%		%		%		%		%		%	
2. What do you feel when you see a chimp?												
Calm	47.4	48	87	11.7	89.6	9.7	57.8	35	42.9	50	48	16.9
Afraid	49.4	46.1	90.6	5.5	92.9	6	69.8	26.4	55.5	37.4	55.5	12.1
	$\chi^2 = 0.13, P = 0.71$		$\chi^2 = 3.9, P < 0.0482$		$\chi^2 = 1.57, P < 0.02107$		$\chi^2 = 3.86, P < 0.0495$		$\chi^2 = 5.77, P < 0.0163$		$\chi^2 = 2.4, P = 0.30$	
3. Why are people afraid of chimpanzees?												
Attack	45.4	48.4	87.8	8.3	91.3	7.4	65.5	28.4	56.8	34.5	43.2	10.5
Don´t attack	52.8	46.1	92.1	7.9	89.9	10.1	67.4	31.5	37.1	61.8	77.5	22.5
	$\chi^2 = 0.63, P = 0.43$		$\chi^2 = 0.04, P = 0.82$		$\chi^2 = 0.56, P = 0.45$		$\chi^2 = 0.07, P = 0.78$		$\chi^2 = 15.26, P < 0.0001$		$\chi^2 = 62.13, P < 0.0001$	
6. Why do you wash clothes in the river?												
More water	48.8	47.7	87.4	9.5	91.2	8.4	67.9	26.3	49.2	43.5	56.1	15.6
There is nowhere else	48.6	44.5	95.9	4	91.9	5.4	52.7	43.2	52.7	41.9	39.2	9.5
	$\chi^2 = 0.05, P = 0.81$		$\chi^2 = 2.45, P = 0.12$		$\chi^2 = 0.65, P = 0.42$		$\chi^2 = 7.47, P < 0.0063$		$\chi^2 = 0.15, P = 0.69$		$\chi^2 = 13.94, P < 0.0009$	
7. Why do you have to throw the old clothes in the forest?												
Habit	50.6	46.5	91.8	7	91.1	8.2	68.8	26.5	51.8	41.2	54.1	15.3
Nowhere else	51.2	43.8	87.6	9.9	91.7	7.4	63.6	33.1	42.9	52.1	58.7	14.9
Doesn´t do it	26.7	60	100	0	100	0	80	6.7	66.7	26.7	73.3	6.7
	$\chi^2 = 2.51, P = 0.28$		$\chi^2 = 2.23, P = 0.33$		$\chi^2 = 1.35, P = 0.51$		$\chi^2 = 4.44, P = 0.11$		$\chi^2 = 5.09, P = 0.0782$		$\chi^2 = 2.53, P = 0.64$	
8.-Thirty years ago, were there more trees in town?												
Yes	53.5	43.2	90.9	7	90.5	8.2	65	30	51	44	53.5	12.3
No	32	66	90	8	94	6	68	26	44	46	58	12
	$\chi^2 = 8.34, P < 0.0039$		$\chi^2 = 0.06, P = 0.8$		$\chi^2 = 0.31, P = 0.58$		$\chi^2 = 0.28, P = 0.59$		$\chi^2 = 0.35, P = 0.55$		$\chi^2 = 0.37, P = 0.83$	
11. How many forest fires have there been in the last year?												
0 fires	50	50	80	10	80	20	50	50	30	70	30	50
1 fire	46.5	50.9	89.5	9.6	94.7	4.4	70.2	25	58.8	33.3	50.9	14
2 o more fires	57.6	38.6	90.9	7.6	88.6	9.8	61.4	34.1	43.2	52.3	59.8	9.8
	$\chi^2 = 3.56, P = 0.17$		$\chi^2 = 0.38, P = 0.82$		$\chi^2 = 4.67, P = 0.09$		$\chi^2 = 3.72, P = 0.15$		$\chi^2 = 10.08, P < 0.0065$		$\chi^2 = 14.34, P < 0.0063$	

Table A.5. Associations between Animism and some questions of chimpanzee conservation.