The impact of agriculture on the biodiversity in the Boé region (Guinea Bissau)

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1. Introduction

1.1. Objectives of the study

The author conducted an agro-ecological survey in the Boé between the 11th of February and the 9th of June 2014 as part of his "external teaching practice" as defined by the University of Leuven (Belgium). The general objectives of these external teaching practices is to obtain experience and skills in doing biological fieldwork.

The study itself was executed within the Chimbo/Daridibó programme in the Boé of Guinea Bissau. These two organisations seek to secure a safe environment for the Chimpanzee population in the Boé sector of Guinea Bissau, and to conserve the habitat of these animals sustainably. Chimbo/Daridibó supports the establishment of a national park by IBAP (National Institute for Biodiversity and Protected Areas) execute activities in Chimpanzee research and organizes, trains and equips Village Vigilance Committees (CVV's) in 28 villages to assist with the protection the Chimpanzees. Chimbo also, develops an eco-volunteer programme, works on awareness and nature education programmes in particular through the local radio, has initiated a bush fire control programme, and implements a limited number of general well-being activities to support the local people that it works with (e.g. drinking water, rice-banks, emergency evacuations in case of illness and accidents, etc.).

The specific objective of this study is "*to investigate the human impact on nature*".
It is not yet known if local people are aware of their impact on nature in all its consequences. In this study the aim is to investigate the human impact on nature. To clarify this human-nature conflict it will be necessary to look whether or not people think about which woodland patches they cut down first, how sustainable their farming activities are, where they go to hunt, what species- and how many they hunt,...

2. Materials and methods

Since this study was the first of its kind within the Chimbo programme, the author developed his own research protocol. The study is making a distinction between two complementary parts: A biological part (focusing on Chimpanzee ecology), and an agricultural part. The study was executed in three phases, shortly described hereafter:

- Phase 1

The preparation of the actual field work started in Belgium with the consultation of available literature. In Guinea Bissau the literature findings were completed with information from reconnaissance field visits and discussions with Chimbo/Daridibó staff, notably with Mr. Joost van Schijndel, field collaborator of the Chimbo Foundation in charge of the commitments that Chimbo entered into with the Max Planck Institute (Leipzig, Germany) for the PanAf project in the Boé.
During the field trip, 4 days were spent on preparing 3 transect-walks through dense forests at Aicum, the research site located in the future national park. One day was used to walk one of the transect-walks. During the transect walk all signs of wild animals were registered and different types of habitat were recorded. During another 2 days the phenology of the chimpanzee habitat was observed and recorded: One day in the forest of Toentegï, and another day the phenology on the hills of Aicum. For the phenology survey individual trees are observed every month during one year in order to gain insight in their seasonal appearance. The trees investigated are the most important tree species for chimpanzees in this region.

- Phase 2

During this phase a first impression of the actual agricultural system was obtained by a survey of different farmers in the Boé region. This was completed with the consultation of available literature and with the personal experience of Chimbo staff.

Table 1 presents the number of hypotheses that were formulated to be tested during the field surveys and interviews with farmers. A list was prepared to interview farmers. Questions can be categorized as follows:

- ✓ General questions about the farmers' personal situation, the situation on his agricultural fields and activities,
- ✓ Specific questions concerning the field on which he planned to work on this year
  - o the kind of crops he would grow
  - o the work plan on this field
  - o the environment of this specific field
- ✓ Questions about his livestock
- ✓ His hunting and fishing activities
- ✓ Questions about alternatives for his agricultural work and income
- ✓ Finally, the farmers opinion on nature conservation was discussed

Table 1: Hypotheses to be tested during the agricultural survey

- Chimpanzee population suffers from current agricultural activities
- Chimpanzees are eating crops
- Farmers are eating the same wild fruits as chimpanzees do
- Farmers hunt chimpanzees
- Farmers hunt other wildlife
- Farmers are farming in sustainable ecological ways: They think about WHAT type of plants they plant (e.g. beans, rice, …) They think about WHERE they plant (e.g. on riverbanks, in gallery forests,…) They think about HOW OFTEN they cultivate the same field (duration of fallow)
- Agriculture occurs in good potential chimpanzee territory
- Agriculture occurs in habitat of lots of wild animal species
- Farmers have a lot of livestock as source of protein
- Each farmer has its own field(s) and only works on its own field(s)
- Each farmer has a (cashew)plantation for extra nutrition and income
- Farmers are supportive of a nature reserve to conserve nature and the remaining wildlife

After the interview with each farmer, a visit was made to the field that the farmer planned to exploit that year. During this field visit, first observations were made concerning the location of the field, the types of habitat next to the field and the size and condition of the field.

As described above, 11 different farmers from 3 different villages were selected and 13 field observations were made. One farmer had 2 agricultural fields on which he planned to work that year, and from another farmer's field a field and a plantation were surveyed. 5 of the farmers interviewed and whose fields were visited came from the village of Béli. In Pataque, a village 7 kilometers to the north of Béli, 3 farmers were interviewed and their fields visited. 'Béli singo' (literally translated as 'little Béli') is a small village 2 km to the south of Béli, where the remaining 3 farmers were interviewed and their fields visited. The selection of farmers chosen for the survey, depended on the location of their agricultural fields. For the field observations it was decided to observe different fields in a widespread area instead of investigating 13 fields in one small river valley. The fields and farmers selected covered a work grid of 120 square kilometers (Figure 1). This work was all done with the assistance of a local Chimbo collaborator from Béli who helped in connecting with and selecting the different farmers.

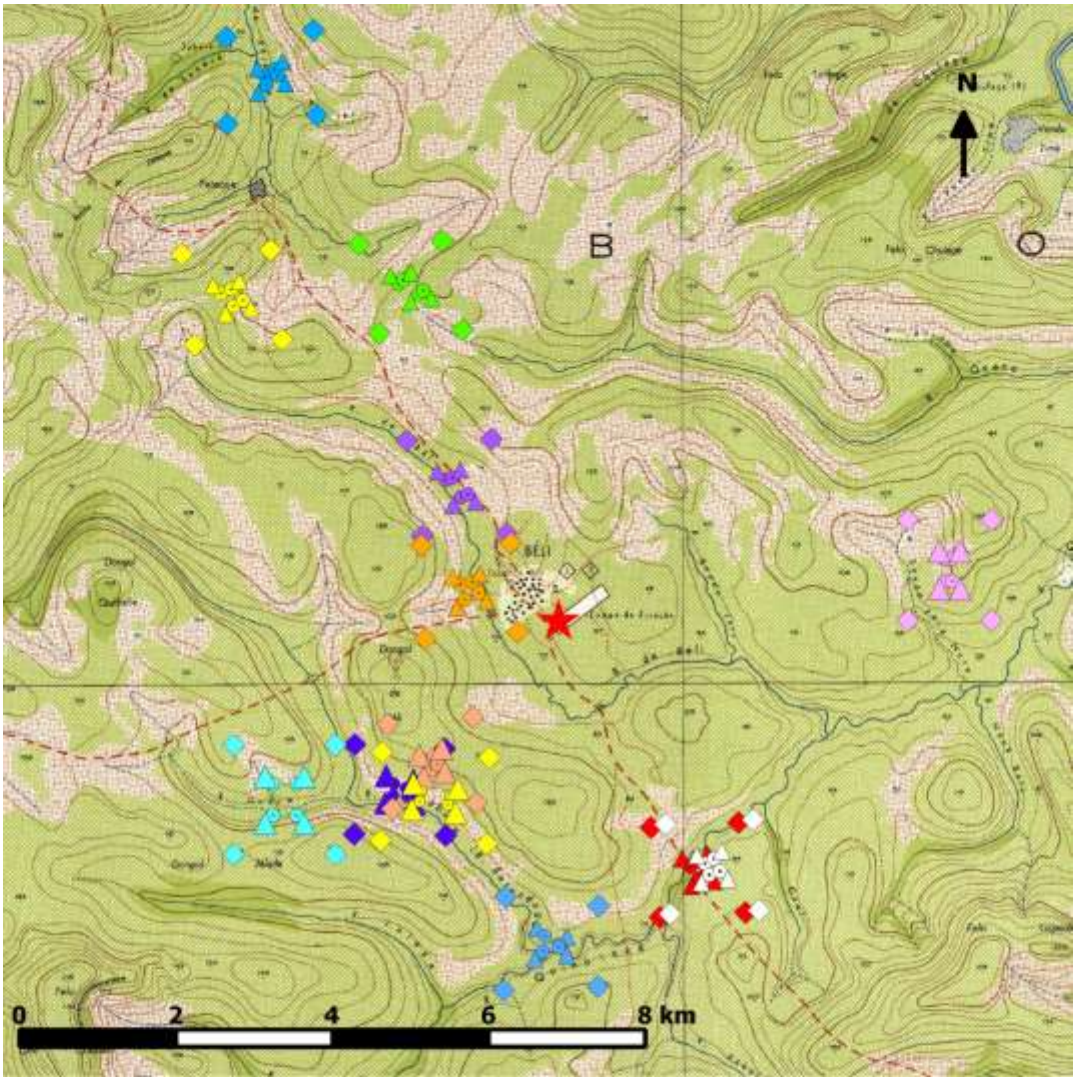


Figure 1: Total surface of the research area. The 13 different colours represent the 13 agricultural fields. The red star in the middle represents the basecamp in Béli.

- Phase 3

To obtain data that can be used to quantify actual impact of an agricultural field on the surrounding nature, it was decided to walk 2 square shaped transect lines next to each selected field. Each transect formed a square around the field at respectively 100 and 500m distance from the field's edges (figure 2). During these transects all tree species important for chimpanzees were registered together with every sign of wild mammal species, within a 30 m. wide band at each side of the transect line. A local guide with good knowledge of all the tree- and animal species was employed to assist with this part of the research. It has to be noted that at places the vegetation was very dense, which made the detection of trees beyond 5 m. from the transect line difficult. The actual location of each agricultural field was registered in QGIS. The exact start and end point of the transect lines were also calculated in QGIS.

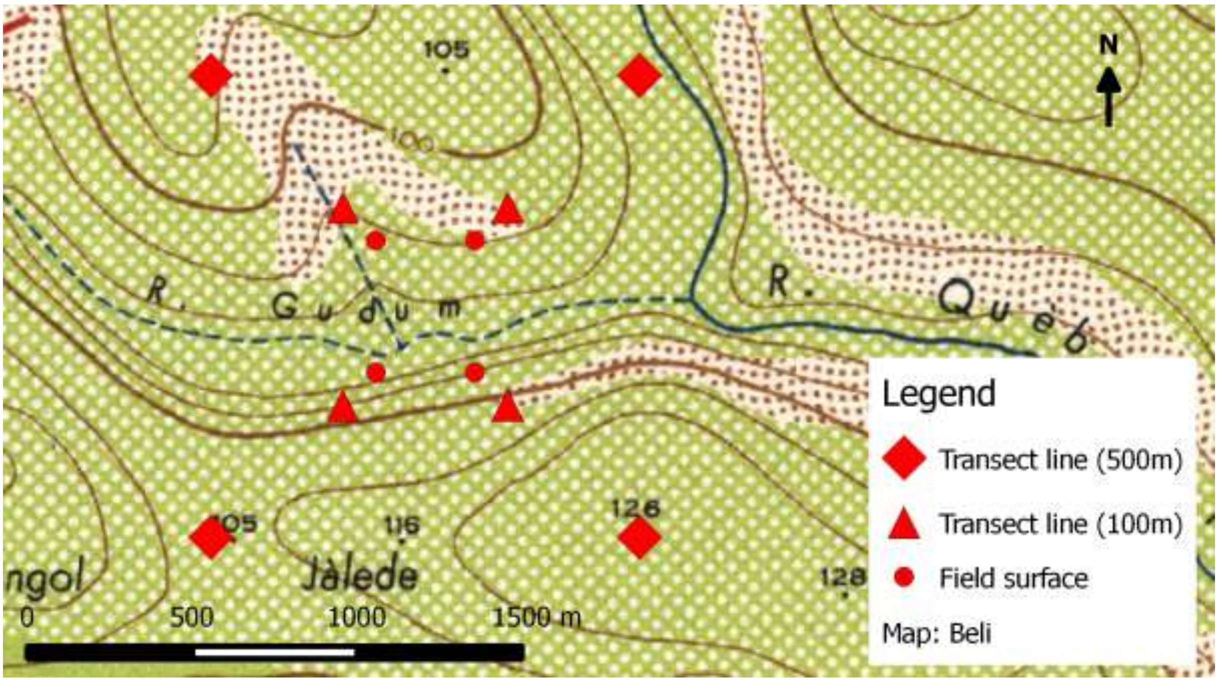


Figure 2: Example of an investigated agricultural field.

In preparing for the observations on the transects, a list of animal species from the Boé region was put together. The list of all mammals (about 40) recorded in the Boé region was translated into Criolo (a national language derived from Portuguese) and Phoular (the local African language). The same was done for selected tree species that are known to be the most important tree species for the chimpanzees in this region. Chimpanzees use over 200 species of trees for food sources and to build nests. The 15 most important species were selected in consultation with the Chimbo staff. Afterwards 3 other species were added to the list as these were also important in chimpanzee ecology and were present in high numbers in many transect lines. Also a list was made up with 10 different types of habitats in the Boé region. During the transect walks it was recorded when and where the habitat type changes to enable the calculation of the distance walked in each different type of habitat, for every transect line. The lists with different animal and tree species and different types of habitats can be found tables 2, 3 and 4.

By using this working method it is possible to compare data further away from the field with the data close to the field to see if there is an actual change in the presence of animal tracks or availability of important chimpanzee trees. These observations of the transect lines were processed in excel.

Table 2: List of the 18 most important trees for the Chimpanzee community in the Boé region.

Afzelia africana	*Elaeis guineensis*	*Parkia biglobosa*
Ceiba pentandra	*Erythrophleum africanum*	*Piliostigma thonningii*
Cola cordifolia	*Ficus sur*	*Pterocarpus erinaceus*
Cordyla pinnata	*Hexalobus monopetalus*	*Saba senegalensis*
Detarium senegalenses	*Lannea velutina*	*Sorindeia doeringii*
Dialium guineense	*Parinari excelsa*	*Spondias monbin*

Table 3: List of mammals existing in the Boé region which were observed during the transect walks. Scientific names are given in the right column.

English name	***Scientific name***
Aardvark	*Orycteropus afer*
African wild dog	*Lycaon pictus*
Bohor Reed Buck	*Redunca redunca*
Bushbuck	*Tragelaphus scriptus*
Campbell's Mona Monkey	*Cercopithecus mona*
Canerat	*Thryonomys swinderianus*
Caracal	*Caracal caracal*
Civet	*Civettictis civetta*
Common Hippopotamus	*Hippopotamus amphibius*
Common Warthog	*Phacochoerus africanus*
Giant Forest Hog	*Hylochoerus meinertzhageni*
Giant Ground Pangolin	*Manis gigantea*
Grey (Common) duiker	*Sylvicapra grimmia*
Hausa Genet	*Genetta thierryi*
Honey Badger	*Mellivora capensis*
Leopard	*Panthera pardus*
Lion	*Panthera leo*
Maxwells Duiker	*Cephalophus maxwellii*
North African Porcupine	*Hystrix cristata*
Oribi	*Ourebia ourebi*
Patas Monkey	*Erythocebus patas*
Red/Forest Buffalo	*Syncerus caffer nanus*
Red Flanked Duiker	*Cephalophus rufilatus*
Red River Hog	*Potamochoerus porcus*
Roan Antilope	*Hippotragus equinus*
Savannah Buffalo	*Syncerus caffer caffer*
Scrub Hare	*Lepus saxatilis*
Serval	*Leptailurus serval*
Side Striped Jackal	*Canis adustus*
Sitatunga	*Tragelaphus spekei*
Slender Mongoose	*Galerella sanguinea*
Sooty Mangabey	*Cercocebus atys*
Spotted Hyaena	*Crocuta crocuta*
Striped Hyaena	*Hyaena hyaena*
Vervet Monkey	*Chlorocebus sabaeus aethiops*
Waterbuck	*Kobus ellipsiprymnus*
Water Chevrotain	*Hyemoschus aquaticus*
Western Baboon	*Papio cynocephalus papio*
Western Chimpanzee	*Pan troglodytes verus*
Western Red Colobus	*Procolobus badius temmincki*
Western Ground Squirrel	*Xerus erythropus*
Yellow Backed Duiker	*Cephalophus silvicultor*

Table 4: List of different habitat types in the Boé region, registered during the transect walks.

Forest	Old arable land (>4 years fallow)
Gallery forest	Young arable land (<4 years fallow)
Savanna	Active arable land (the year in process)
Bushy savanna	Plantation
Woodland savanna	Village

3. Results of the literature- and reconnaissance surveys

3.1. General description of Guinea Bissau

Guinea-Bissau is one of the smallest countries in coastal West Africa, bounded by Senegal to the north and by Guinea-Conakry to the south and east. The country totals 36,120km2 in area (Kormos et al. 2003) and is made up of mainland as well as a number of offshore islands (the Bijago´s Archipelago). It is a low-lying country with highest point at 260m in the Boé region. Most of the country receives 1,500–2,000mm of rain yearly (1992). Temperatures in Bissau are at their lowest in January (24.7°C) and their highest in July (28.0°C). Small areas of primary subtropical forests are still found in the south-west (Tombali and Quinara regions) and in the north-west (Cacheu region).

The estimated population of Guinea-Bissau is about 1,300.000 inhabitants with an annual population growth rate of 2.2%. Population densities are higher in the north-west (c. 42 people per km2), while the southern and eastern parts of the country are sparsely populated (15 people per km2), this also covers the Boé region (Portas and Oliveira Costa 1985). Several ethnic groups live in the country, the major ones being the Balanta and the Fula (this last one also lives in the Boé). Guinea-Bissau is one of the ten poorest countries in the world. GDP is $174 US per capita (Kormos et al. 2003). Farming is the main occupation of the people.
Guinea-Bissau became independent from Portugal in 1974. A civil war in 1998 created hundreds of thousands of displaced persons. Ever since this country has witnessed instable situations. The last putsch took place in 2012. In May 2014 presidential elections were organized. Hopefully, these presidential elections will bring new stability in the governmental organization of the country which would help the developing of ecotourism. This ecotourism could provide a highly needed source of financial income for the country. Primates, particularly chimpanzees, are among the most visible elements of the biodiversity of Guinea-Bissau and have an important role to play as ‘’flagship’’ species for the conservation of nature in this country (IUCN 2003).

3.2. General description of the Boé

The Boé region is a sector in the southeast of Guinea-Bissau and part of the Gabu Province. It is situated between the Corubal river and the border with Guinea-Conakry. The landscape of the Boé is composed of rolling hills covered by savanna vegetation dissected by narrow valleys where forests grow. Most of the Boé is covered by a lateritic hardpan of up to 20 m. thick, with a thin layer of soil where only shallowly rooted grasses and other herbs can thrive. This hardpan contains Bauxite deposits. This typical landscape is also known in neighbouring Guinea-Conakry, where it is called 'bowel', from which the name of the Boé is derived (P. Wit 2013).Where the hardpan is cut by narrow valleys, there is limited acreage where the soil can provide enough fertility for agricultural activities. In these valleys dense forests used to grow, which farmers have cut down to exploit the soils for agricultural activities. Given the poverty of these soils, even of the most fertile ones, the agricultural land has to lay fallow for an average of 7 years after one harvest. Because of this long fallow period a lot of forest habitat had to be cut down to provide enough agricultural land for the human population. In the remaining forest patches at the source of the streams and along the ridges, a rich nature was conserved with the West-African chimpanzee as its flagship species.
In these rare forest-habitats a great diversity of wildlife occurs. Not only do farmers destroy the habitats of wildlife, they also hunt and poach directly wild animals. This, aggravated by the continuous growth of the human population in the Boé, causes serious impacts on chimpanzee populations and on biodiversity in general. Recently IBAP (institute for Biodiversity and Protected Areas) has started a process to establish a National Park in the north zone of the Boé region, situated around the confluence of the Rio Féfiné and Rio Corubal.
In 1986, the population size was 6500 persons. Nowadays 12.000 people are living in the Boé, divided over 85 villages and campsites which means that the human population has about doubled in 30 years’ time. With the present system of land use, the Boé has reached the limits of its capacity to support the human population (P. Wit, 2013).

Chimbo/Daridibó have their office and field station in Béli (800 inhabitants), the administrative centre of the Boé.

3.3. Situation of Chimpanzees

3.3.1 General information about Chimpanzees in Africa

Chimpanzees *(Pan troglodytes*) are the most widespread of all the great ape species. *P. troglodytes* and all its 4 subspecies are classified as 'Endangered' (Oates et al. 2009, Hilton-Taylor 2002).
For the East-African chimpanzee (*P.troglodytes schweinfurthii*) the biggest problems are poaching (for meat and pet-trade), habitat loss and fragmentation (mainly due to expanding agricultural land) and the transmission of diseases (IUCN Eastern Chimpanzee Action Plan 2010). Illegal trade is difficult to control by African governments (*e.g.* in the Democratic republic of Congo and the Central African Republic), even with increased supervision (Kormos et al. 2003).

The Boé- Chimpanzee occurs belongs to the West African subspecies *Pan troglodytes verus*. Historically its range covered 12 countries, but it has gone extinct in Benin and Togo and it is on the brink of extinction in Burkina Faso, Senegal and Ghana (Lee et al. 1988, IUCN 1996). IUCN estimates a total number of 38.000 chimpanzees in West-Africa (2003). The 2 largest chimpanzee populations of West-Africa can be found in Guinea-Conakry and Côte d'Ivoire. Between 1990 and 2008 a decrease of up to 90% in abundance of chimpanzee nests has been observed in Côte d'Ivoire. At the same time, the human population in Côte d'Ivoire increased with 6 million people from 12 million to 18 million. Campbell et al. attribute 50 % of the observed decrease in chimpanzee numbers to higher deforestation- and hunting rates that come with demographic growth.
The population in Guinea-Conakry was estimated at 17.600 individuals.. More information about the behavior and ecology of the West-African chimpanzee in general, as part of the literature study, can be found in annex 1.

3.3.2 Chimpanzees Guinea Bissau

- Occurrence of Chimpanzees in Guinea Bissau

Although in 1988 chimpanzees were declared extinct in Guinea-Bissau (Lee et al. 1988), evidence has shown the presence of chimpanzees throughout the south of the country (Monard 1940; Limoges 1989). IUCN estimated the Guinea-Bissau population of *P.troglodytus versus* between 600 and 1000 individuals in 2003. Chimpanzees were considered in the south-east regions of Quinara and Tombali by Gippoliti and Dell'Omo (1996). Monard (1940) and Limoges (1989) considered Chimpanzees common in the Boé. Limoges observed three groups and 26 individuals in the hilly woodlands of the Boé region during a nation-wide survey. Gippoliti and Dell'Omo, estimated a total of about 600 –1000 Chimpanzees in the country in 1995. Nowadays it is estimated that 700 chimpanzees are present in Boé region alone (Serra et al. 2007)

- Threats to chimpanzees in Guinea-Bissau

Agricultural expansion is the main cause for destruction of Chimpanzee-habitat in the country. Forest degradation and destruction appears to be the primary threat to chimpanzee survival in the Tombali and Quinara regions. The Cantanhez Forest cover is becoming seriously fragmented to make space for banana-, cashew- and other fruit plantations. Crop raiding by Chimpanzees is seen as an increasing problem by the villagers of the Cantanhez region which may lead to repercussions to the raiding animals (Kormos et al. 2003). Chimpanzees are not hunted for meat in Guinea-Bissau, as has been reported for other regions of West Africa (Duvall et al. 2003, Chapter 6). In Guinea-Bissau chimpanzees – locally known as ''dari'' – are not generally used for human consumption because ''they are too similar to humans.'' In the Boé people say they shelter the spirit of elders. This creates a positive social environment for chimpanzee conservation. However, the hunting of wildlife by snares – reported for example in the Cantanhez Forest, which is officially a hunting reserve– represents a risk to chimpanzees.

- Policies and legislation in conservation

Chimpanzees are fully protected by law. The “Parque Natural das Lagoas de Cufada”, established in 2000, harbours the most western population of Chimpanzees in Africa. The Park covers about 700 km². Chimpanzees can be observed with relative ease in the Cantanhez Forest, in the Tombali region. It is the last primary sub humid forest in the country but it is suffering severe habitat degradation and fragmentation. IBAP is in the process of creating a new National Park in the Boé. A corridor will be established to physically connect this Protected Area with the network of other protected areas in Guinea Bissau. This network of protected areas will be important for other threatened species threatened species believed to occur until recently in the Boé region which include the African wild dog (*Lycaon pictus*) and the giant eland (*Tragelaphus derbianus*) (IUCN 2003). The last species is now believed to be extinct in the country (personal information Piet Wit).

- Priority actions for chimpanzee conservation in Guinea-Bissau

In the year 2003 the IUCN states that given the high population growth and the poor economic situation of Guinea-Bissau, conservation objectives will likely not be considered as a priority by the government in the near future . Nevertheless the IUCN recommends at the same time a number of conservation actions to be undertaken such as the development of a national strategy for chimpanzee conservation, the establishment of protected areas a/o in the Boé and to encourage the development of ecotourism in one or more of the protected areas. The great diversity of landscapes and biological importance of this small country could support a number of conservation projects dependent on wildlife tourism. The possibility of establishing a research and habituation program to encourage tourism in one or more of the protected areas should be investigated. An ecotourism program could generate income for local communities without the risk of seriously increasing poaching problems (IUCN 2003). Formenty et al. (2003)observe that chimpanzees and humans share many similar diseases and precautions must be taken to avoid transmission from tourists to habituated apes and vice-versa. Any ecotourism project would have to be well researched and planned and to have very strict regulations.
The IUCN called in 2003 also for studies to understand what conservation tools are better suited to assure the long-term conservation of the chimpanzee and other wildlife species in the Boé sector. For example, according to Pruetz et al. (2001)the coexistence of chimpanzees with cattle herders can be highly successful in West African savanna habitats

3.4. Characteristics of agriculture

3.4.1 Agriculture in Guinea Bissau

Red/reddish-brown lateritic soils (with kaolinite), and the grey/ black margalitic soils (with montmorillonite) are typical soils for tropical zones. The clay minerals kaolinite and montmorillonite are completely different in characteristics and properties, the former being "hydrophobic" and with a relatively low adsorption capacity, whereas the latter is characterized by strong swelling when wet, and a high adsorption capacity. Strongly weathered lateritic soils are generally very poor in plant nutrients, the more so as the porous structure of the soil favors the leaching of the nutrients. The reddish color is due to the high iron content. Maintenance of fertility can be solved by judicious fertilizing (J.G. De Geus 1967). In order to maintain the productivity of their land productive, farmers must pay attention to the following factors: Erosion control; Water regulation by either water conservation and irrigation or drainage, (depending a/o on climatic conditions); Crop rotation; appropriate tillage; Maintenance of organic matter; Acidity or alkalinity (pH) adjustment; and last but not least, the addition of all nutrients that are in short supply for optimum plant production (J.G. De Geus 1967).

3.4.2. Agriculture in the Boé

A good picture was obtained of the main agricultural activities in the region around Béli. As social and environmental conditions are more or less the same all over the Boé, we assume that agricultural activities in the rest of the Boé are comparable to the situation around Béli.

Most of the surveyed farmers are illiterate, as is the case with the population of the Boé in general.

Land conversion for agriculture, bush fires and hunting are the most important impacts of the farming population on the ecosystems and wildlife of the Boé. These will be dealt with in more detail in the following sections.

- Slash and Burn Farming

Every man in the Boé region is a farmer. The crop growing season starts with the beginning of the rain season and harvests come in from September onwards. Even in the better years harvests do not provide sufficient food for the Boé population, and import of rice is necessary.
In the Boé, almost every patch of forest is converted into a farm field following a cycle of slash-and-burn agriculture and fallow. 80% of the farmers surveyed confirm that their field used to be a dense forest with many different tree species. The other 20% claimed that their fields had always been under agricultural use. Given the similarities of the fields, these 20% of the fields must also have been dense forests once. Almost all river valleys are converted into farmland applying a rotation of agriculture followed by on average 7 years of fallow. Land closer to the river may be re-used after 5 years of fallow.
Usually a mix of 4 crops is grown with rain-fed rice as the main crop. The others are sorghum, maize and peanuts. There are a lot of different varieties for each of these crops. Farmers know which variety should be planted where but could not explain to the surveyors why a certain variety should be sown at a specific place. Beans are nitrogen fixating crops and may be planted on less fertile soils or together with other crops resulting in higher productions than when grown separately. According to the farmers, there is a problem with the availability of the bean seeds.

The only way applied to fertilise the field is to lay the land fallow. Manure or compost is not applied. At the end of the fallow period all shrubs and trees are felled and the bark of the biggest trees are ringed. After that the field is burned. People start burning the fields at the beginning of the first rains in mid-May. Burning of agricultural land only is permitted at the condition that (i) a fire-break is made around the field, ((ii) to wait after the first rains and (iii) to stay at the field while it is burning in order take action when the fire may get out of hand. Unfortunately people in the Boé do not respect these conditions and a much is burned around the month of May.

On deforested riverbanks soil erosion will be accelerated. The soil with its nutrients and minerals is washed away by the rains. In the long term this implicates rivers with low water levels and poor soils. This is the opposite of sustainable farming. People should keep at least 20 meters of the riverbank untouched, with trees to keep the soil together. However, local people are convinced that the presence of the Red Hiver Hog (and the Common warthog) will maintain water in the rivers as rivers will become deeper because of the burrowing by these animals. Not shooting (and eating) these animals will help to conserve water levels in the rivers.

- Plantations

Sometimes farmers work two years in a row on the same field in the case that they are planning to establish a plantation. In the second year they plant the tree seedlings (mostly cashew, *Anacardium occidentale*) together with some peanuts and cassava. From that year onwards, this field will remain a plantation. These plantations are the solution to make money every year and to feed the family, compared to growing rice and a mix of other crops and then wait for another 7 years before gaining anything from that field again. Nowadays every man is in possession of a cashew or mango plantation, or a combination of both. People with big plantations also have oranges, pineapples, limes, avocados,... But the most important ones are the cashew plantations, leading to a monoculture of orchards and a decrease in biodiversity.
Some women may know how to dry mango's but it is hardly practiced. They don't have the right techniques and have problems with proper conservation.

- Hunting and gathering

People do hunt for wild animals, mostly porcupine, bushbuck or duiker species. People that don't hunt themselves, may buy bush meat from local hunters. Monkeys are very rarely hunted. It is illegal to hunt any Chimpanzee. People in the Boé believe that chimpanzees are reincarnated people who committed a sin in a previous life and are therefore punished to live in the woods. Therefore people do not eat or shoot these creatures that look too much like humans.
For religious reasons wild pigs (Common Warthog and Red River Hog) are not eaten and therefore not hunted.

Not only the farmers are responsible for forest fires. Hunters also set fires for a number of reasons: fire may be used to drive animals into the direction where they may hunted; fire improves visibility and destroys possible hiding places for the game; finally hunters can walk through forests without making noise since the litter will also be burned. Nowadays almost every farmer has a locally made rifle as well as a bicycle to reach the most remote places of the Boé.

People in the Boé region are still for 30% dependent on food sources of wild fauna or flora. Besides hunting for wild animals, they also eat a lot of wild fruits. The most important wild fruits for humans often are also the most important fruits for chimpanzees (see fig. 3).
During the survey some alternatives for food from the wild were suggested to the farmers. Some of them had eaten grasshoppers (*Schistocerca gregaria*) which may form large groups and eat part of the crops when they pass by. All farmers eat termites when they fly in great numbers at the onset of the rainy season (mid-May). Almost none of the farmers ate any frog- of snail species. Eating frogs is not a feasible alternative in the Boé as many species are poisonous, and people have difficulties with identification.

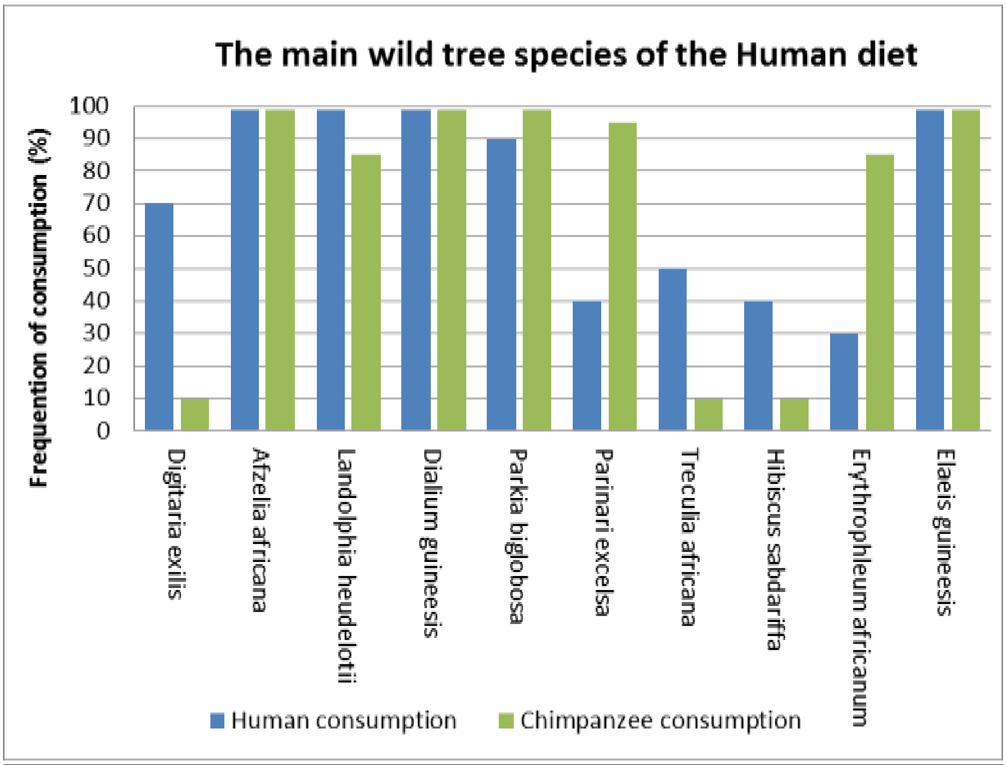


Figure 3: 10 wild fruit species mostly eaten by the human population of the Boé. Blue bars show the percentage of people that eat this species. Green bars show the same for the chimpanzee population.

- Animal husbandry in the Boé

Besides by hunters and farmers, bush fire in the Boé region is put by herdsmen. The savannas provide grazing opportunities for herds of *Ndama* cattle mostly owned by people from neighbouring Guinea-Conakry. The presence of these herdsmen is a relatively recent development as in 1986 hardly any livestock could be found in the Boé (P. Wit, 2013).During the dry season these herdsmen set annual fires in the savanna in order to provoke a green re-growth of the perennial grasses to feed their cattle.

The resident Fula communities in the Boé may own some goat and sheep. Usually 2 or 3 goats are being slaughtered per year for a celebration, such as marriage, beginning of rain season or the moment of harvest. Most of the wives know how to milk goats, but not all of them do it, due to small and sick goats. Some people have cows but this is expensive and not easy to manage.
A lot of domesticated dogs are present in the Boé, mostly used as guarding dogs. Dogs are not eaten, as by some ethnic groups in Guinea-Conakry.
Most people own some chicken, but lots of chickens die due to *Coccidiosis*. The parasite is mainly transmitted by faeces or infected tissue. Young animals are most vulnerable to this disease. Humans, Cats, dogs and other birds species may have to cope with this parasite as well, but in the Boé only chickens have serious trouble with this parasite. Medication is expensive and hardly available, especially not in the Boé region.
Donkeys and horses cannot survive in the Boé due to *Trypanosomiasis* (sleeping sickness), a disease transmitted by tsetse flies that is everywhere in the Boé.

- Human – wildlife conflict

The cashew and other fruits-crops are being eaten by a wide range of wildlife species, especially monkeys and chimpanzees. For that reason most of the plantations are located as close as possible to the villages, where wild animals don't dare to come too quickly. Other agricultural crops may also be eaten by wild animals, and children have to guard the fields during the harvesting period to scare away the animals and reduce the damage. Monkeys are easily scared away by throwing stones. Chimpanzees only eat sugarcane. Most people simply don't plant sugarcane for this reason. Common Warthog and Red River Hog dig and burrow in the earth to eat part of the roots. These animals are active at night and difficult to scare away. [1]

4. Results of the transect observations

The number of tree species observed each 100 meters over a transect line is on average higher for the transect lines at 100m than at 500m distance from the fields (see figure 4). However, the number of animal tracks observed each 100 meters over a transect line is on average lower for transect lines at 100m than at 500m distance from the fields (see figure 5). The same can be observed for tracks of Chimpanzee presence: their number is on average higher at 500 meters distance to the fields than at 100 m. (see figure 6).

[1] The cultural/religious taboo on not eating monkeys and wild pigs, is losing ground. Youngsters and people from outside the Boé with a different religion more and more hunt and eat these species. Chimpanzees may be trapped incidentally in which case the young may be sold for the pet trade. On rare occasions Chimpanzees may be killed to protect the crops. (*note by P.Wit)*

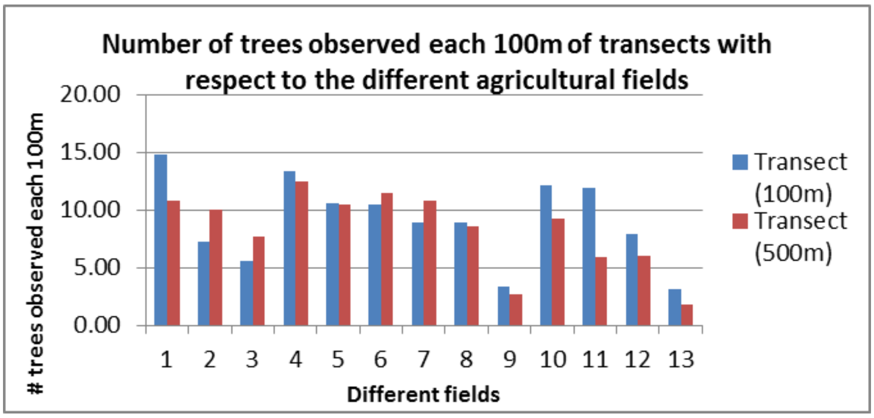


Figure 4: Number of trees observed on each 100 meters walked over a transect line. Blue bars show transect lines at 100m, red bars at 500m distance from the fields' edges. The horizontal axis represents the 13 different agricultural fields.

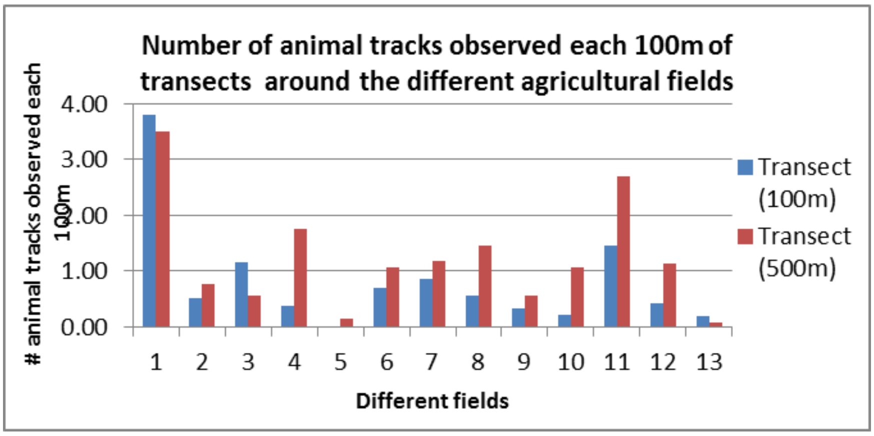


Figure 5: Number of animal tracks observed on each 100 meters walked over a transect line. Blue bars show transect lines at 100m, red bars at 500m from the edges of the observed fields. The horizontal axis represents the 13 different agricultural fields

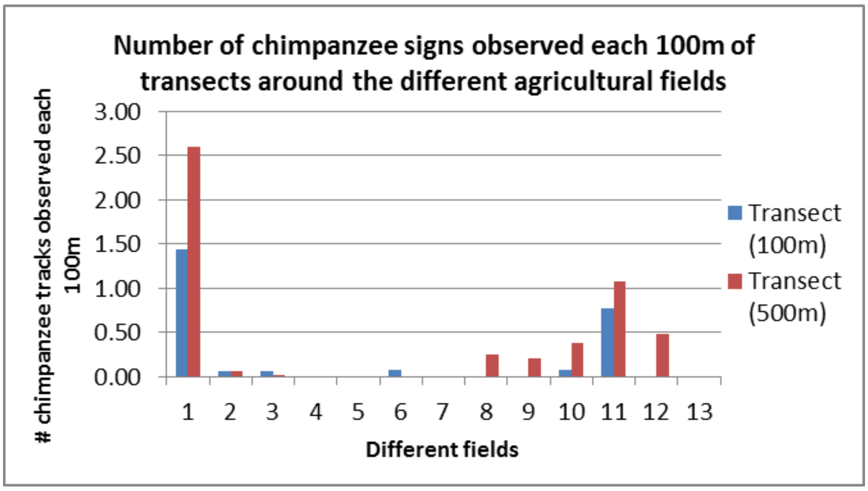


Figure 6: Number of signs of Chimpanzee presence (faeces, footprints, nests, food tracks, visual encounter, hearing encounter) observed on each 100 meters walked over a transect line. Blue bars show transect lines at 100m, red bars at 500m from the fields' edges. The horizontal axis represents the 13 different agricultural fields

Concerning the diversity, the trees as well as the animal track showed more different species on transect lines at 500m than at 100m next to the different agricultural fields (see figure 7 and 8).

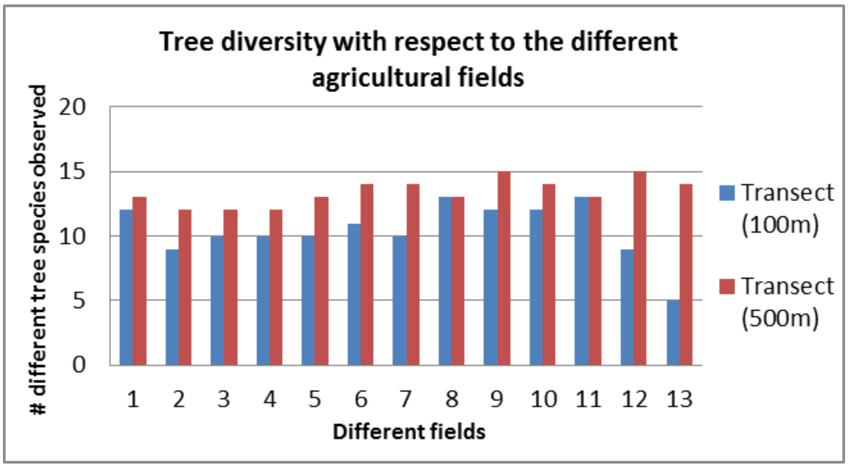


Figure 7: *Diversity of tree species observed during transect walks next to each agricultural field. Blue bars show transect lines at 100m, red bars at 500m next to the fields. The horizontal axis represents the 13 different agricultural fields. The maximal diversity is 18 because there are only 18 selected tree species which were observed during the transect walks.*

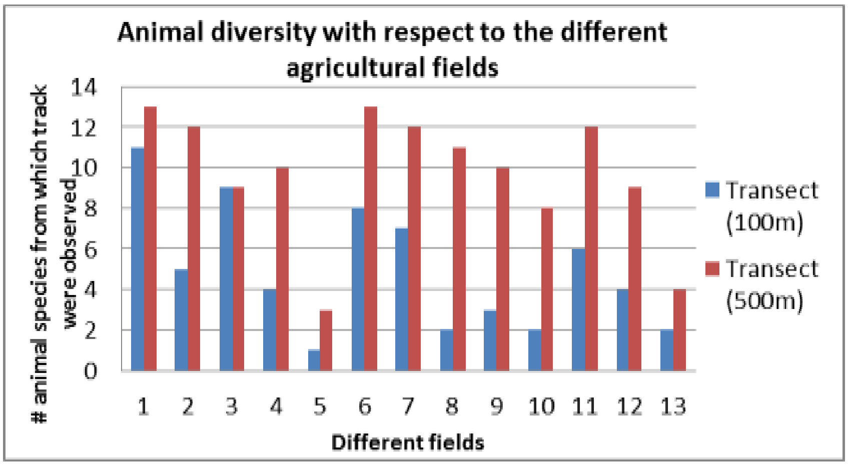
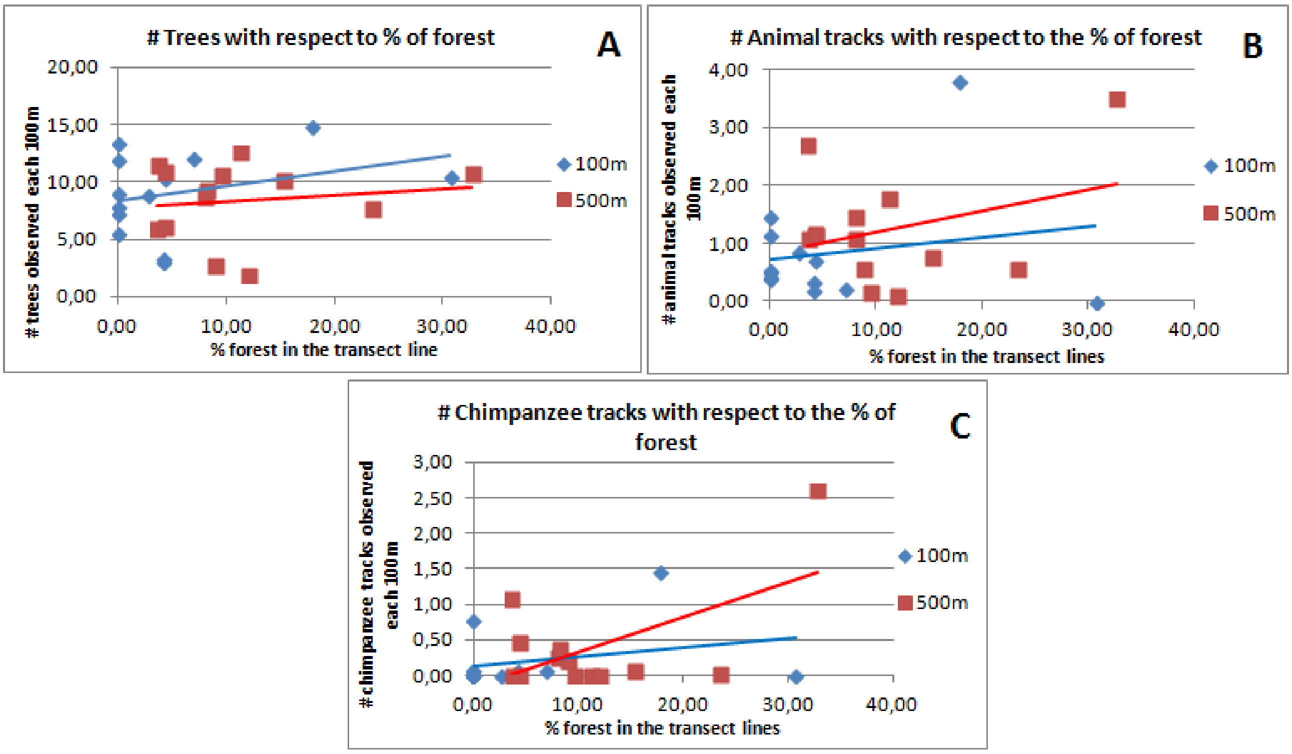


Figure 8: *Diversity of animal species observed during transect walks next to each agricultural field. Blue bars show transect lines at 100m, red bars at 500m next to the fields. The horizontal axis represents the 13 different agricultural fields. The maximal diversity is 40 because there are about 40 living mammal species in the Boé region.*

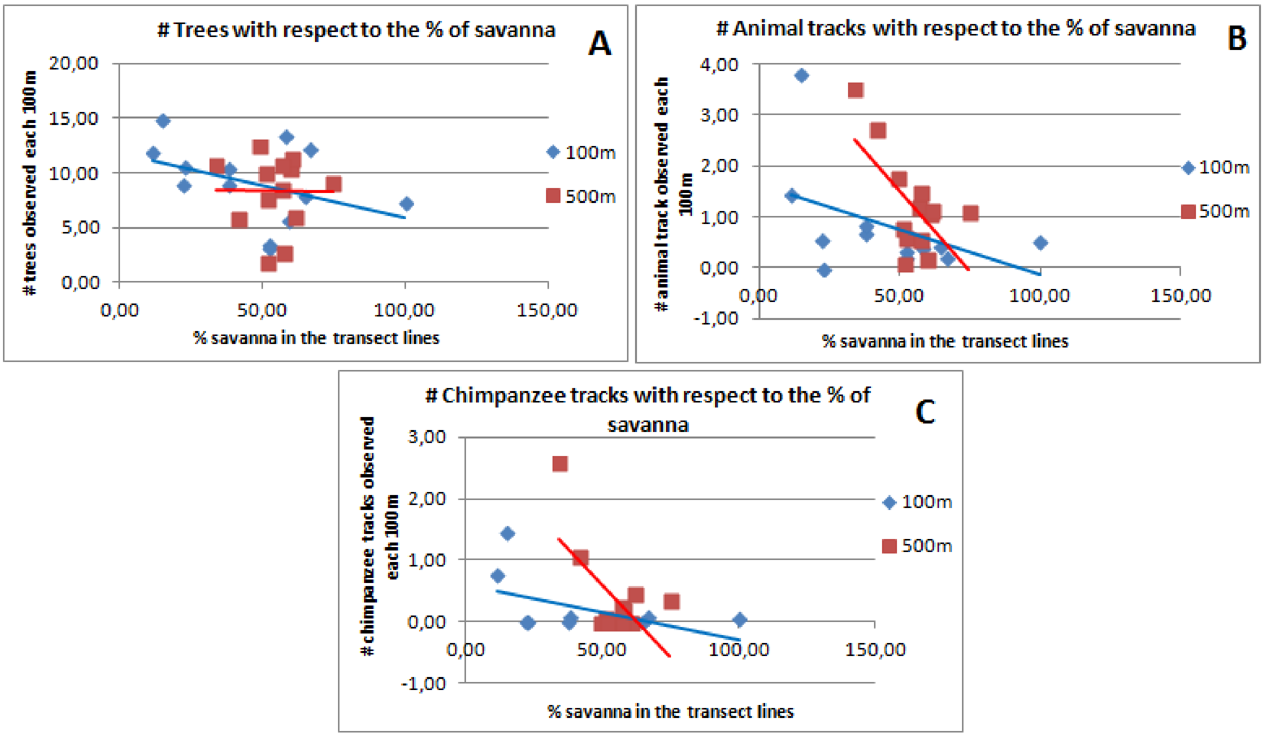
Table 4 shows the percentage of the distances that the transect lines passed through the different habitat types. Combining the results of this table with the data of the tree and animal observations on the transects, leads to the following observations (see also figures 9, 10, 11 and 12). The number of tree species as well as the number of animal and Chimpanzee tracks observed increase with an increasing percentage of the transect line through forest habitat. The more the transect lines pass through savanna habitat, the less animal tracks, as well as chimpanzee tracks are observed. The more the transect lines pass through agricultural fields, the easier it is to observe a lot of tree species, animal tracks and chimpanzee tracks.

Table 4: Percentage of the transect lines going through different types of habitat. 8 different habitat types are aggregated to 3 main types. The type 'Forest' covers forest and gallery forest, the type 'Savanna' covers savanna, bushy savanna and woodland savanna and 'Arable land' covers the old-, young and active agricultural fields.

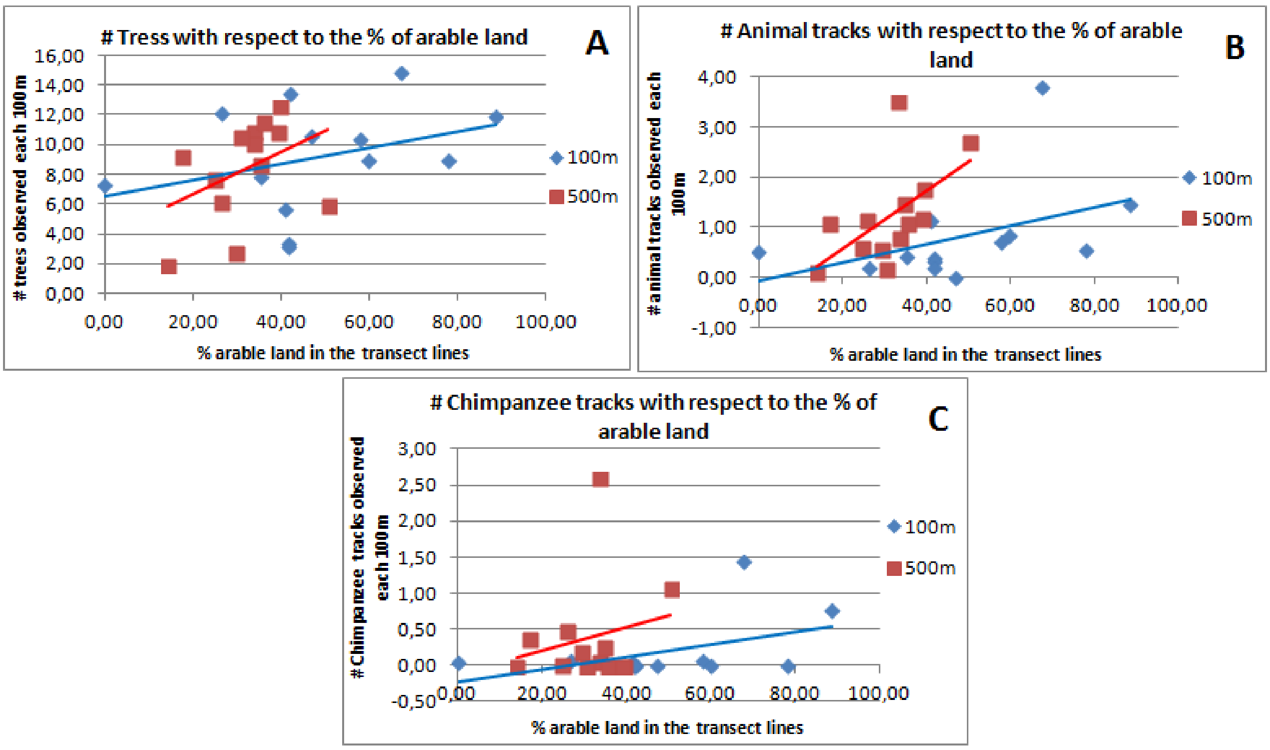
field	Type of habitat	% of transect line through this habitat type	
		At 100 m from field edge	At 500 meters from field edge
1	Forest	17,8	32,7
	Savanna	14,9	33,8
	Arable land	67,3	33,5
2	Forest	0,0	15,3
	Savanna	100,0	51,1
	Arable land	0,0	33,6
3	Forest	0,0	23,4
	Savanna	59,0	52,0
	Arable land	41,0	24,6
4	Forest	0,0	11,2
	Savanna	58,1	49,2
	Arable land	41,9	39,6
5	Forest	30,6	9,5
	Savanna	22,6	59,8
	Arable land	46,8	30,7
6	Forest	4,2	3,7
	Savanna	38,0	60,6
	Arable land	57,7	35,7
7	Forest	2,6	4,3
	Savanna	37,7	56,7
	Arable land	59,6	39,0
8	Forest	0,0	8,1
	Savanna	22,0	57,0
	Arable land	78,0	35,0
9	Forest	6,1	12,9
	Savanna	52,4	57,5
	Arable land	41,6	29,6
10	Forest	6,9	8,1
	Savanna	66,7	74,7
	Arable land	26,4	17,2
11	Forest	0,0	8,1
	Savanna	11,5	41,4
	Arable land	88,5	50,5
12	Forest	0,0	12,5
	Savanna	64,7	61,5
	Arable land	35,3	26,1
13	Forest	6,1	23,6
	Savanna	52,4	51,7
	Arable land	41,6	14,1
	Total % arable land	48,1	31,5



*<u>Figure 9:</u> Number of observations with respect to the percentage of transect lines that cross forest habitat. **A**; number of trees observed in each 100 meters of walked transect line with respect to the percentage of forest habitat covering the transect lines. **B**; number of animal tracks observed in each 100 meters of walked transect line with respect to the percentage of forest habitat covering the transect lines. **C**; number of chimpanzee tracks observed in each 100 meters of walked transect line with respect to the percentage of forest habitat covering the transect lines.*
*(Trend line of **A** 100m: y=0,13X+8,43; **A** 500m: y=0,05X+7,73; **B** 100m: y=0,02X+0,71; **B** 500m: y=0,04X+0,82; **C** 100m: y=0,01X+0,12; **C** 500m: y=0,05X-0,16)*



*<u>Figure 10:</u> Number of observations with respect to the percentage of transect line that crosses savanna. **A**; number of trees observed in each 100 meters of walked transect line with respect to the percentage of savanna habitat covering the transect lines. **B**; number of animal tracks observed in each 100 meters of walked transect line with respect to the percentage of savanna habitat covering the transect lines. **C**; number of chimpanzee tracks observed in each 100 meters of walked transect line with respect to the percentage of savanna habitat covering the transect lines.*
*(Trend line of **A** 100m: y=-0,06X+11,8; **A** 500m: y=-0,04X+8,53; **B** 100m: y=-0,02X+1,63; **B** 500m: y=-0,06X+4,62; **C** 100m: y=-0,01X+0,6; **C** 500m: y=-0,05X+2,92)*



*<u>Figure 11:</u> Number of observations with respect to the percentage of transect line that crosses arable land . **A**; number of trees observed in each 100 meters of walked transect line with respect to the percentage of 'arable land' habitat covering the transect lines. **B**; number of animal tracks observed in each 100 meters of walked*

transect line with respect to the percentage of 'arable land' habitat covering the transect lines. ***C****; number of chimpanzee tracks observed in each 100 meters of walked transect line with respect to the percentage of 'arable land' habitat covering the transect lines.*
(Trend line of ***A*** *100m: y=0,05X+6,49;* ***A*** *500m: y=0,14X+3,93;* ***B*** *100m: y=0,02X-0,07;* ***B*** *500m: y=0,06X-0,61;* ***C*** *100m: y=0,01X-0,23;* ***C*** *500m: y=0,02X-0,13)*

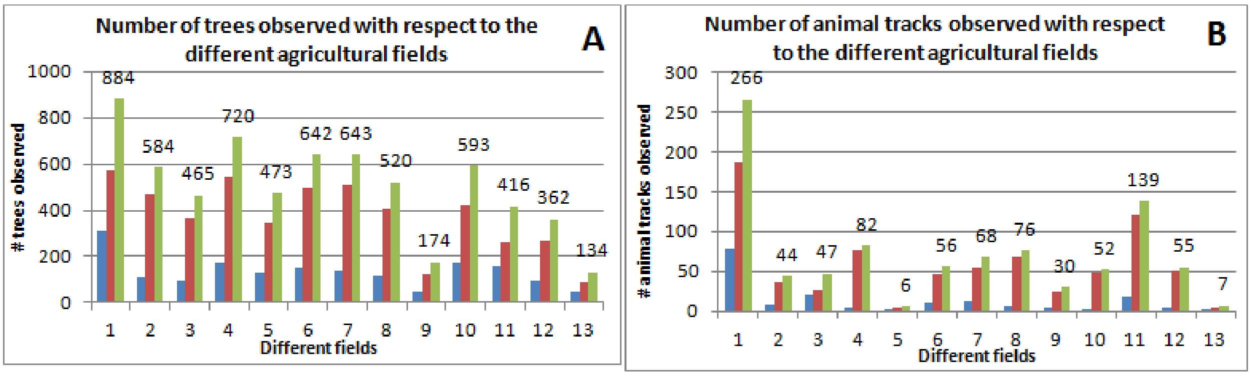


Figure 12: Total number of observations with respect to the different agricultural fields. ***A****, shows the total number of tree observations during the different transect walks.* ***B****, shows the total number of animal track observations during the different transect walks. Blue bars indicates the number of observations made on transect lines at 100 meters next to every agricultural field. Red bars indicates the numbers of observations made on transect lines at 500 meters next to every field. The green bars represent the total number of observations at every field (sum of the blue and red bars).*

5. Discussion

The results of the farmers survey make it obvious that chimpanzee populations in the Boé region actually suffer from humans presence mainly due to a decrease of the quality and extent of their habitat. Once dense forests have been converted to farm land. When we discuss the stress on the environment because of an ever growing population, they don't see the problem. They just don't believe that reducing the number of children will be a solution to cope with the annual famine. Also a few hunters literally confirmed that it is no problem to hunt because 'Allah' has created all the animals so that they can hunt them down. Some older hunters nevertheless testify that it's getting harder to find and hunt down the same animals compared to 20 or 30 years ago. In spite of the decline of wild animal populations, hunters, even these old ones, keep on hunting just as much as they used to do. The present way of life in the Boé region cannot be sustained. It depletes the environment with negative consequences also for fauna and flora.

Figure 12 presents the total number of all trees and of all animal tracks observed during the transects walks. The total number of observations is higher for transect lines at 500 meters distance around a field compared to the at 100 meters distance to the same field. This can be expected as the rectangles at 500 m. distance are obviously much larger. Figures 4 and 5 present the number of observations per 100 meter of transect for each of the two categories of transects. Figure 4 shows that the number of trees observed on each 100 meters of all transect lines in most cases is higher for the transect lines at 100 meters than at 500 meters distance to the fields. In other words, there are more important 'chimpanzee tree species' close to the agricultural fields than farther away from the fields. This is not what we may expect, because most of the trees would be cut down when agricultural fields are made. But it proves that agricultural activities take place in good chimpanzee territory and that, the farther you go away from the fields the less suitable the environment will be for chimpanzees, proven by the declining fact of the most important tree species. [2] On the other hand the number of animal tracks per 100 m transect is in most cases higher for the transect lines at 500 meters than at 100 meters next to the fields (figure 5). It is expected that most wild animals are present farther away from agricultural activities. Also most chimpanzee signs were found on transect lines at 500 meters next to the fields (as you can see in figure 6).

These results are regardless of any kind of different habitat types that the transect lines cross, which could give another perspective when taken into consideration. Figure 11 shows more trees, animal tracks and chimpanzee signs are observed when the transect lines cross any type of agricultural field (old, young or active). This may not be what is expected when walking through agricultural fields. A plausible explanation could be that animals come to this fields to eat part of the crops and therefore are more present at agricultural sites than in forests or savanna habitats. However the transects were run during the dry season when there are no crops on the fields to attract wild animals. Some tracks found in mud could be remainders of tracks made during the wet season but we know from the farming survey that most animals are scared away during that time and chimpanzees for example normally don't come for any planted crops. Also, faeces don't last for more than 1 or 2 months, especially not in this climate, so all the faeces observed must be from the dry season at a time that there were no crops to attract these animals. It is possible that more animal track get registered on (old or young) agricultural fields because there is no, or much less litter which makes it easier to spot the tracks. Agricultural fields are almost always close to a river. Therefore may attract wild animals in the dry season when water sources are rare. The higher number of tree observations on agricultural fields can be explained by their presence on places where dense forest used to grow with many different tree species, including the 18 most important species for chimpanzees. In other words good healthy chimpanzee territory had to make place for agricultural fields. The farming survey reveals that virtually all forests have been converted to farm fields, leaving little alternatives for wild animals to feed on agricultural land and associated fallow.

Figure 9 shows that the more a transect passes through forest habitat, the more tree species, animal- and chimpanzee tracks can be observed. This seems to be in contradiction with figure 12 where these indicators also show a~~i~~n increase when passing through agricultural fields (see above). For the tree species the slope of the trend line is close to zero (figure 9A) and the number of tree observations hardly increase with an increasing percentage of forest on the transect line. Comparing the trend lines in figure 9B and 11B, the observations of animal tracks on transect lines at 500 meters from the fields, increased more with a higher percentage of agricultural habitat than with the same increase in percentage of forest habitat. On transect lines at 100m next to the fields there is less difference in slopes, but it is important to notice that in this case the correlation is based on observations on transect lines covered for 10% or less by forest habitat. Extrapolation to 40 % forest cover gives these trend lines a speculative aspect. The fact that forest soils are covered by more litter can be an additional explanation why less observations were made in forest habitats. Figure 9C, concerning chimpanzee observations, shows that most chimpanzee tracks are spotted on transect lines with only 15% or less of forest habitat. This is because there are only few forest habitat patches left in the Boé region. Most of the chimpanzee observations are in form of chimpanzee nests, and these are almost always made in forest habitats. This explains the steeper slope of the trend line in figure 9C (forest habitat on transect lines at 500 meters from the fields) comparing with the slope of the trend line in figure 11C (agricultural complex at 500 meters).

For discussing the third but most present habitat type, a look at figure 10 is necessary. It is clear, by considering the slopes of the trend lines of this figure, that both animal- and chimpanzee track observations as well as tree registrations decrease with an increasing percentage of savanna presence on the transect lines. A little more

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[2] *This lack of trees at 500 m distance is also an indication that all forests at these locations are converted to agricultural and fallow land. In many cases, 500 m. distance from farm field means that one is on the hardpan where no tree can grow and no land can be tilled for agricultural purposes. (note by P.Wit)*

than 50% of the tracks went through savanna habitat. Savanna is the most widespread habitat type in the Boé region. In a savanna habitat a wider view makes it possible to spot more trees and with no litter, especially after a fire, animal tracks are easily observed. Animal tracks on savanna are more exposed to the elements of nature which affects the conservation of these tracks. From our data it can be concluded that walking in savanna will not reveal many tree- and animal track observations.

Figure 7 and 8 make demonstrate that 500 meters away from agricultural fields a lot more diversity was registered than closer to the fields. More different tree species as well as tracks of different animal species were found further away from the agricultural fields. This is not unexpected and it implicates a negative agricultural impact on the biodiversity. However, this conclusion needs to be nuanced as transect lines at 500 meters distance from an agricultural field may cross through more or through less agricultural habitats than transect lines at 100 meters distance to the same field. Table 4 presents the total percentage of agricultural habitat that a transect passes through at 100 meters distance to a given farm field as well for the transects at 500 meters distance to the same field. 48% of all transect lines at 100 meters distance from the fields went through agricultural habitat while only 31% of all transect lines at 500 meters went through agricultural habitat. Considering all this we may conclude that there is an indication of agricultural impact on biodiversity.

6. <u>Conclusions and recommendations</u>

6.1 Conclusions

The people in the Boé region live in an society that cannot be sustained, considering the population growth that goes hand in hand with the increasing import of rice and increasing number of (cashew)plantations. The exploitation of the forest habitats for agricultural reaches its limits as almost every suitable habitat has been converted into agricultural fields. People starting to disrespect the proper fallow period of the agricultural fields and continue farming on riverbanks, circumstances that cause negative impact on soil fertility, groundwater levels, and potential future harvests. This way of life also seriously affects the environment and its wildlife.

The biological field work makes it evident that almost all of the remaining forests have been transformed into agricultural fields and that these fields were the best habitat patches for chimpanzees and other wildlife. Results show us that the most important tree (and animal) species are mainly found in and close to agricultural fields, which was best explained by the fact that this patches were once the most suitable places for forests and wildlife in the whole the Boé region. Increasingly agricultural activities take place in the last remaining biodiversity hotspots in the Boé, and therefore these activities have a great impact on the biodiversity in general and on the chimpanzee populations of the region in particular.

6.2 Recommendations

Guinea-Bissau is one of the ten poorest countries in the world, and here, even more than elsewhere in West Africa, biological conservation should be coupled with attempts to stimulate economic growth. Nationally, emphasis is placed on the conservation of the unique coastal and island ecosystems of Guinea-Bissau. However, an opportunity exists to plan effective protection of inland-forested areas and encourage chimpanzee-watching tourism in the country.

Some activities for alternative income generation were initiated in the sideline of this study (see Annex II). These may provide inspiration for future activities of sustainable development in the Boé.

ANNEX I

Behavior and ecology of the West-African chimpanzee

Feeding behavior

Feeding behavior in chimpanzees varies seasonally and is greatly influenced by food availability and habitat type. It is becoming apparent that there are differences in species eaten across sites that cannot be explained by differences in their biotic environments and that reflect traditional and potentially cultural variants between communities (McGrew 1992). Chimpanzees are omnivorous and have a diverse diet although fruit pulp usually comprises the largest portion of their diet. Leaves and woody pith are the next two most important food types for the chimpanzees, as well as seeds and the pith of herbaceous plants (Yamakoshi 1998). Flowers, bark, roots and tubers, tree gum and insects such as adult termites (*Isoptera sp*.), ants (*Dorylus sp*. and *Oecophylla longinoda*), and the larvae and eggs of ants, bees and several species of beetles are also eaten by the western chimpanzees. Different chimpanzee communities incorporate different insect prey into their diet, with some .being ignored at some sites while consumed at others, as it is also seen by some plant species (McGrew 1992). At some sites chimpanzees are known to hunt for animal pray, mostly other mammalian species. One chimpanzee community in the Taï forest in Côte d'Ivoire is known to hunt frequently on animal pray, mostly other primates but they have a strong preference for the Western red colobus (*Procolobus badius*) (Boesch-Achermann 2000). These chimpanzees have developed a sophisticated collaborative hunting strategy, unique among non-human primates, mainly involving males of the community who gain rewards for their contribution to the hunt by acquiring a share of the meat (Boesch and Boesch-Achermann 2000b). But meat sharing also involves other members of the community including females and youngsters.

The proportion of food items in the chimpanzee diet may also vary significantly across seasons. Plant species that show little inter-annual variation, either in the amount of resources produced or in the seasonal timing of availability, are termed ''keystone resources'' or ''fallback foods'' (Terborgh 1986). Fig trees (*Ficus sp*.), for example, constitute one of the main keystone food resources for chimpanzees across many field sites, due to their aseasonal fruiting patterns and general year-round availability. Also the oil palm tree (*Elaeis guineensis*), who provides them with year-round food resources, including the rich mesocarp of the fruit, the oily nut kernel, the petiole of young palm fronds, the base of immature flowers, the pith of mature leaves and the sugary and nutritious palm heart, is an outstanding example of a "keystone resource". In addition, it appears that during times of hardship, chimpanzees effectively increase their tool use activities (e.g., nut cracking and ant dipping) in order to gain access to otherwise inaccessible food resources and to boost their energy intake (Yamakoshi 1998). During periods of fruit scarcity, chimpanzees will rely and concentrate on different ''keystone resources'' or ''fallback foods,'' which will depend on their habitat and the feeding traditions of their community.

Nesting behavior

Chimpanzees build arboreal nests every night. Chimpanzees build their nest by preparing a foundation of solid side branches or forks, bending, breaking and inter-weaving side branches crosswise (Fruth and Hohmann 1996). They complete this arboreal construction by bending most of the smaller twigs in a circular fashion around the rim. Detached twigs are sometimes added for lining (Goodall 1968). Chimpanzees may also build nests during the day for resting. These nests are usually in trees, although there have also been reports of use of ground nests in several communities. Nests may range from very rough and superficial structures, usually day nests, to carefully built night nests. Chimpanzees do not hesitate to combine trees when these interface, but usually they use only one tree.

Chimpanzees are selective in the choice of their nesting site. Indeed, most studies of nesting in chimpanzees reveal that nests accumulate in specific areas depending on forest type and proximity to water and food resources (Baldwin et al. 1982; Groves and Sabater Pi 1985; Kortlandt 1992). Even there are indications that chimpanzees have preferences for nesting material and for the height at which nests are constructed (Wrogemann 1992; Fleury- Brugiere 2001). During Ham's nationwide survey of chimpanzees in Guinea from 1995 to 1997, the species of tree were identified for 573 nests. Preferred species varied between regions. But the most frequently used species of trees for nesting are *Erythrophleum suaveolens*, *Elaeis guineensis*, *Parkia biglobosa* (Ham 1998). Gippoliti and Dell'Omo (1995) also reported that almost all chimpanzee nests they observed in Guinea-Bissau, close to the border with Guinea, were constructed in oil palms (*Elaeis guineensis*). This preference for oil palms as nesting tree looks to be a recent development. Earlier, in 1967 Bournonville preformed a survey in Guinea-Conakry and observed only one nest build in this oil palms. The recent preference for oil palms can also be linked with the increasing rates of deforestation. Oil palms tend to be of better value for the local people as they stay in the woods, allowing people to take the nuts to make palm oil. There for, there is still a high abundance of this tree species in this area. Sind oil palms are also "keystone species" for chimpanzee, it was not to difficult for the animals to change their nesting behavior towards building nests in this oil palms.

The availability of different habitat types appears to strongly influence the choice of nesting sites in chimpanzees, but they do seem to prefer certain habitat types over others. In the Haut Niger National Park in Guinea-Conakry, Fleury-Brugière (2001) found that gallery forests contained 40% of the nests found, whereas they made up only 6% of the area under survey. Dry forest, which covered 27% of the study area, was also preferentially used, harboring 40% of the nests. However, savanna ecosystems were rarely used for nesting. The chimpanzees living outside the park may be deterred from nesting in those forest areas as human habitation is usually situated near watercourses. As a result, human presence may influence nesting behavior in chimpanzees and could potentially put them at risk of predators, e.g., leopard (*Panthera pardus*), since other habitats where they are forced to nest may not provide them with sufficient protection, especially at night (Pruetz et al. 2001).

During her survey of chimpanzees in Guinea, Ham (1998) found that the height at which nests were built varied across regions. The average height for the nests used was 17.65m+0.23 (n = 923, Range = 0–37m). These differences in nest height may be influenced by the habitat (McGrew et al. 1981), predation and also possibly by climatic variables, e.g., wind factor, rainfall and sunlight accessibility.

<u>Demography</u>

In the wild, chimpanzees are known to live for more than 40 years. Mean inter-birth interval is 5.9 years at Taï forest in Côte d'Ivoire (Boesch and Boesch-Achermann 2000b) and 4.4 years at Bossou forest in Guinea-Conakry, which is remarkably short compared to other sites (Sugiyama 1999). Such a large inter-birth interval reflects the long maternal investment that is characteristic of chimpanzees. Also typically for chimpanzees, females that emigrate by the age of puberty (9–13 years old), and males that remain within their natal community (Goodall 1983; Hiraiwa-Hasegawa et al. 1984; Boesch and Boesch-Achermann 2000b). One of the threats to the long-term survival of chimpanzees in West Africa is the fragmentation of their habitat. Studies from the chimpanzees at Bossou reveal how such habitat disturbance can modify both demographics and behavior. No immigration of females has ever been recorded in this forest.

<u>Social organization</u>

Social interactions in chimpanzees may also be rather complex, demonstrating capacities for cooperation, reconciliation and coalition or alliance formation. In chimpanzees, the male hierarchy is generally heavily formalized, as males frequently communicate their status to one another, while the female hierarchy is rather vague, since status communication is rare among females. Chimpanzees are able to employ social strategies to obtain certain goals, e.g., food or access to females. Chimpanzees groom each other, which on one hand has a hygienic function through removal of ecto-parasites, and on the other hand serves a social function. Used as a social tool, mutual grooming can reinforce bonds between individuals, reduce social tension and create alliances between non-related individuals. Finally, chimpanzees have a highly developed social system and structure which is strongly reminiscent of that observed in humans and reflects their remarkable ability for social intelligence (Byrne and Whiten 1988).

Ranging behavior

Ranging behavior in chimpanzee populations may vary depending on the quality of the habitat and community size. Inter-specific and intra-specific competition for food and predation risk may also be important determinants of the ranging behavior. The range can vary from 6km², for a population of 16-20 individuals in Guinea-Conakry, to 278-333km², for a population of 28 individuals in Senegal. This last one is very uncommon and is the range of the most north situated community of all of the West-African chimpanzees. It has been proposed that chimpanzees of this community may have to range further to fulfill their dietary requirements (Baldwin et al 1982).

Tool use and tool-making

Chimpanzees make and use a diverse and rich kit of tools and, with the exception of humans, they are the only living primates to consistently and habitually use and make tools. Tool use behavior in chimpanzees has been observed at all field sites where chimpanzees have been studied (Whiten et al. 1999). Each community of chimpanzees has a unique repertoire of tool use behaviors that may differ from that of other communities (McGrew 1992; Whiten et al. 1999). Among all the tool use behaviors observed in the wild, nut cracking is probably the most sophisticated one performed by chimpanzees and has only ever been observed among some populations of the West African subspecies of chimpanzee, although nut-bearing tree species are available at many sites where chimpanzees have been studied elsewhere in Central and East Africa (Boesch et al. 1994; McGrew et al. 1997).

Conclusions

Chimpanzees are highly social and intelligent animals that exhibit great behavioral flexibility and diversity. Their remarkable cognitive ability for social learning, enabling sets of behaviors to be passed on and maintained from one generation to the next, clearly underlies their propensity for demonstrating a wide range of cultural behavioral patterns. It remains essential that management strategies and conservation initiatives in different regions are sensitive to, and incorporate, an understanding of the specific behaviors and ecology of the chimpanzee communities inhabiting these areas. Finally, the observed variation in community-wide behavioral patterns, which incorporate behaviors in the social, communication, nesting and feeding domains, can only urge rapid conservation actions for this species. Indeed, not only would the extinction of chimpanzees represent the disappearance of our closest relatives, but also the vanishing of whole cultural communities (IUCN 2003).

ANNEX II

Sideline Activities

Some extra initiatives were started to help local people to live more ecologically and sustainably. This will be better for themselves, even on short notice, but mainly for future prospects, so upcoming generations can live in a peaceful and healthy environment.

First some workshops were organized with local bakers to use their ovens for drying mango's. There are many mango's in the Boé and people don't have the right technique to dry them properly without rotting, this way a lot of available food goes to waste. Dough is not available every day, as it has to come from Gabu (a big city 100km away), so ovens can be used to dry mango's on the days they don't bake bread. This way a lot of mango's can be dried properly and at short notice. At each of the 3 ovens in Béli a team was put together composed of 3 people who are in charge of collecting mango's and preparing them properly for drying when the oven is available. Afterwards the dried mangos can be distributed all over the village and people can conserve them in plastic bags hanging inside their house. This way, a food source is ensured for times of famine, as it is in the end of the rainy seasons.

Another workshop was organized to make ecological cooking-stoves. People in the Boé cook every day on open fire, sometimes even three times a day. Therefore women have to go into the bush to gather firewood. This gives rise to a large amount of wood being cut, and women have to go farther away from the village each time to find enough wood. When making an ecological stove, much less wood is needed to cook the same amount of food because the heath stays close to the cooking pan and does not escape. Some people in Béli know how to make an ecological stove and already did so. Some of these people even made these stoves in other villages. But still most of the people in Béli don't have one, and continue to waste a lot of wood for cooking. In the work shop 2 different types of stoves were made, and 10 women from Béli were invited to come and take a look how to make these. The goal of the work how was to make 2 different types of stoves at the houses of 2 Chimbo employees. But the most important objective was to help making this stoves for the local women and thereby learning them how to do it themselves so they can make the same stoves at their houses.

The last initiative made was perhaps the most important one. A report was made of these 2 workshops and put in a logical order so that local journalist can read them out on the radio. In this way the information about how to dry and conserve mango's and how to make ecological stoves will be diffused all over the Boé region. And also it can be repeated, because people generally need repetitive explanations before they will actually do something themselves.
Another report was made up to increase awareness about of ecological farming. Therefore people have to be aware of the importance to make little vegetable gardens during the rainy season. They have to be aware how to make a buffer zone when they burn down their agricultural fields so no fire can spread out to the forests, since bushfire is one of the big threats for nature. People also have to maintain a buffer zone on riverbanks, where they should not cut trees closer than 20 meters to the river to ensure a sustainable water level and prevent the erosion of fertile soil. Hunting should also be kept to a minimum, especially pregnant and lactating animals must not be hunted down! Also people should breed more ducks, as they provide good food sources and are, other than chickens, immune for *'Coccidiosis'* (a common chicken disease in the Boé). All these facts where described in a document, translated into French and discussed with local journalists. A schedule was put together to plan which weekly dates the people of the Boé region will be informed with this information through the radio. Especially the mango drying is a hot topic around the months of April until June “the Mango season”, instead of letting these valuable rot away.