



Bartelijntje Buys 2015-16

Drumming in the Boé



*"We shall not cease from exploration
and the end of all exploring will be to arrive where we started
and know this place for the first time"*

T.S. Eliot, 1888-1956

Opening citation in 'Reflections of Eden', Biruté Galdikas, 1995

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Abstract

In Guinea Bissau, West Africa, chimpanzees show a particular behaviour: they return often to the same trees and throw stones at the tree or hit it with stones like playing drums. Often the chimpanzees are looking fascinated at the tree, making supportive sounds before, after and while throwing or drumming. Some chimpanzees make their nest next close to these trees, others don't. This pilot study suggest that this behaviour might have more than one function (e.g. for communication or ritual purposes), and that this functional diversity might be stronger within sacred gallery forests than at other locations (e.g. savannah edge forests, mountain regions).

Note: Accumulative stone drumming of chimpanzees is also recently reported by Kühl *et al.* 2016. This research was done simultaneously, with use of camera footage gathered within the PanAf framework and other sites in Boé. This study adds detailed descriptions of particular drumming environments, trees and drumming behaviour. It is a pilot study and includes interesting observations for future research.

1. INTRODUCTION

Humans have always been fascinated by the behaviour of one of our closest relatives: the chimpanzees. However, in many African regions, chimpanzee populations are disappearing at an alarming rate (IUCN Red List). The Max Planck Institute, Germany, set up a Pan African Programme (PanAf) to enhance our knowledge of evolutionary and ecological characteristics of chimpanzees all over Africa to be implemented in future conservation actions (Vaidyanathan 2011).

In south eastern Guinea Bissau, West Africa, humans do not hunt or severely disturb chimpanzees (*Pan troglodytes* spp. *verus*), because they consider chimpanzees as 'former humans', or at least as 'creatures with human-like cultural habits' (pers. observ., but see also Sousa et al. 2017). Chimpanzees in the Boé throw or drum (hereafter referred to as "drumming") with stones on specific trees, which is remarkable as most other chimpanzee populations in Africa don't. Drumming stones (probably limonite, a relative light iron containing mineral) are often quite big (3-7 kg) and gathered near or inside the trunk. The same drumming trees might be used for many years, as is suggested by bulb formation of tree wound tissue. Hypotheses on the reason for chimpanzee drumming (e.g. for communication, male display or spiritual handling) are left without real evidence, as still only few research is done on this phenomenon (Kühl et al. 2016).

In this pilot study, four drumming tree sites (drumming trees, environment and ecology) are compared as well as chimpanzee behaviour (including drumming) at three different locations (Aicum, Quebube and Tontege) in the Boé-region, Guinea Bisseau (West Africa) though field work and camera footage analysis.

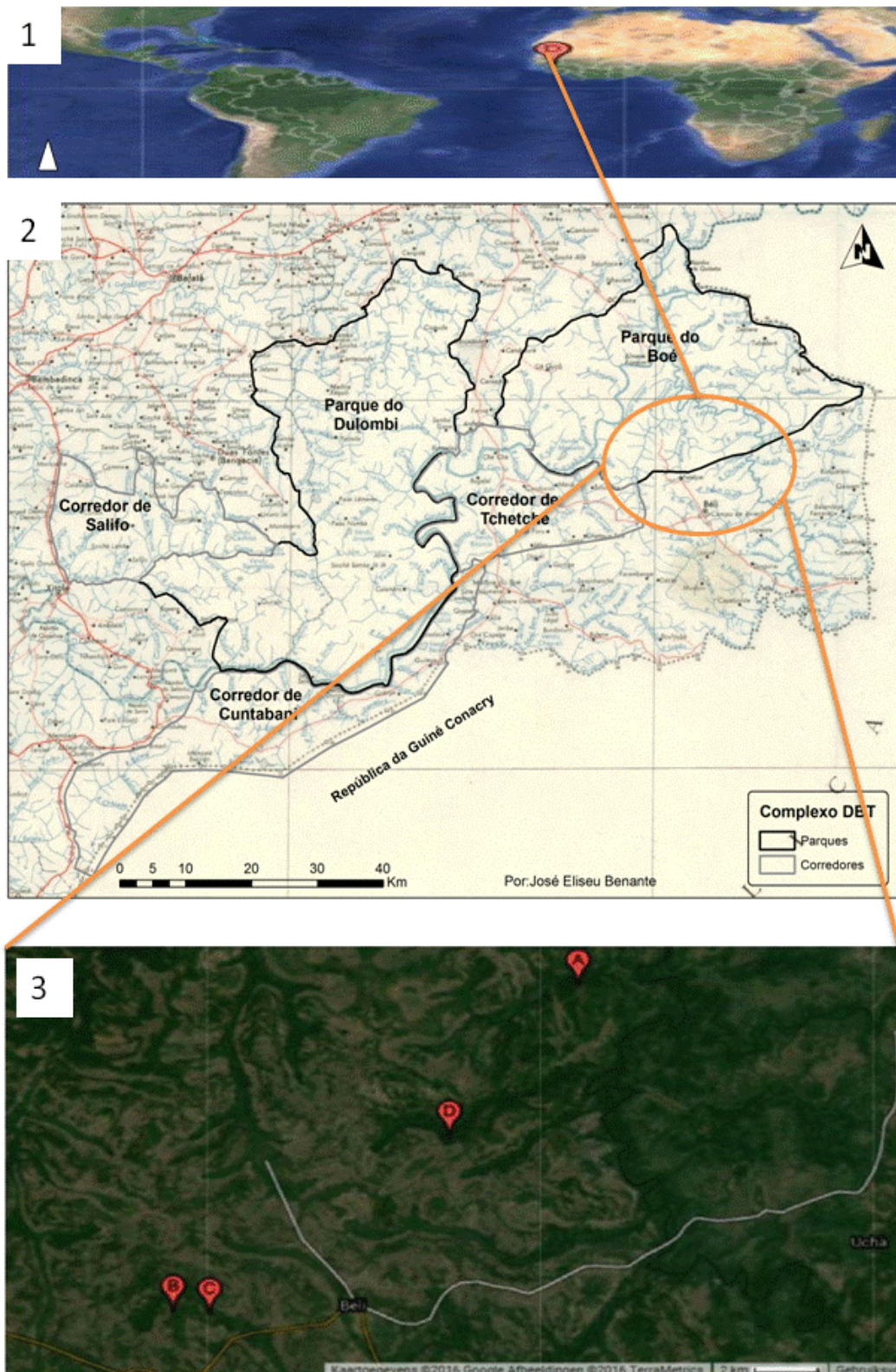
2. METHODS

2.1. STUDY SITE

The Boé sector is a remote area of ca. 3,000 km² of forest edged savannahs in the south-east of Guinea Bissau (13°56'W 11°50'N), bordering Guinea, West-Africa. The rainy season starts in May and ends October (mean yearly rainfall: 1,600-2,000 mm) (Guilherme 2014; Wit and Reintjes 1989). There are only few villages and accessible roads. Slash-and-burn practices for agriculture and subsequent savannah/forest fires are common. Estimations of chimpanzee abundances based on different studies carried out for Chimbo Foundation range between 700 and 2,000. Many field signs (e.g. nests and traces) and camera trap footages suggest a healthy population (with groups up to 17 individuals, pers. observ.). Most chimpanzees live in the wide neighbourhood of villages and not in unpopulated areas (Amadal Camara and Kali Bindia, pers. comm.).

Map 1-3 (next page) shows the Boé region with the three different location of this study: Aicum, Quebube and Tontege. The first, Aicum, lies at the border of the PanAf grid and is part of the Boé National park. It is a quite unpopulated and undisturbed area (difficult to access). It consist both of wetland vegetation, ancient dry mountain forests and some small open savannah spots in between. The second, the Quebube area, is more disturbed by humans (agriculture) and is situated on a plateau of open savannah mixed with small strips of semi-dry edge forests. Tontege then, the third location, is a sacred forest that local people preserve because the “ira” living there will harm those that touch it. It is an very ancient wet ‘gallery forest’, which is proven by some giant tropical trees

(e.g. *Ceiba petandra*). Tontege lies in a depression along a rocky river side.



Map1 , 2 and 3. Guinea Bissau in West-Africa (map 1) with study site (encircled in orange) within the the Boé region (map 2). The position of the trail cameras capturing a drumming tree is marked on map 3. A: Aicum, B & C: Quebube, D: Tontege.

2.2. PLACEMENT OF CAMERA TRAPS AND BEHAVIOURAL ANALYSIS OF FOOTAGES

Table 1. Overview of trail camera positions and settings

Camera nr.	Location name	Habitat type	Long/Lat (UTM)	Camera bearing (°)	Sensor level	Resolution (video size)	Video length (s)
B14	Aicum	Old sec forest/ "dry forest" (mountain)	622277; 1320655	33	HIGH	1280 x 720	60
M2	Quebube 1	Closed woodland/ "savannah edge forest" (plateau)	620643; 1309672	288	HIGH	1280 x 720	60
M3	Quebube 2	Closed woodland/ "savannah edge forest" (plateau)	611684; 1309588	240	HIGH	1280 x 720	60
G10	Tontege	Gallery forest (depression)	61895; 1315567	NA	HIGH	1280 x 720	60

Detailed camera positions and settings are available in table 1 (Bushnell NatureView Cam HD Max, type 119439), following the PanAf protocol (Arandjelovic 2011). In total, four trail cameras were placed all year round capturing each a drumming tree at a different site: one at Aicum, two at Quebube (Quebube 1&2) and one at Tontege (cfr. map 1). More specific: at Aicum on a mountain top (old sec forest), at Quebube within a savannah edge forest (closed woodland) of ca. 100m wide, and in the gallery forest of Tontege, close to a small brook.

Footages of trail camera's during the following months: December 2014, April and June 2015 were analysed¹ with a focus on stone drumming behaviour of

¹ although this was the plan, there were some errors in the data transfer – but see results

² Trees and shrubs were considered as food source of chimpanzees if confirmed by local people and/or classified as such by previous/ongoing studies within the PanAf/ Chimbo program

chimpanzees. Different footages were ordered to facilitate aggregation and analysis of behavioural traits of groups and individuals. The pictures were named as “camera_name_date_hour behavioural trait _composition of chimpanzee group”. The main behavioural traits and their codes (used for renaming) are listed in table 2. Observations on behaviour were noted down by hand and then overviewed in an EXCEL file where rows presented the ID of a single footage and columns specific behavioural and group/individual characteristics. Column names included folder, camera number, location, date, time, picture name, behavioural and group characteristics (see table 2). In addition, screen shots were taken from the footages and pasted in a PowerPoint presentation to make a “catalogue” of different individuals and typical drumming behaviours. VLC media player (version 2.0.0) was used instead of Windows media player as the first is easier to make print screens of a still footage image and has often better sound quality (strengthened by the use of AKG headphones).

Other drumming related traits that were written down :

- the ‘noice’ chimpanzees were making while drumming (e.g. accelerated ‘oohoo’-sounds, loud screams)
- running directly away after drumming or not
- staring at tree before and after drum.

Statistical analysis was not performed due to lack of data (see discussion section). An activity index for each species (see below and Buys 2015) was deduced both as indicator for the frequency of a behavioural trait as for species abundance:

Activity index $I_a \sim \text{amount of events} + \text{amount of individuals in that event}$

2.3. HABITAT DESCRIPTION OF DIFFERENT LOCATIONS AND THEIR DRUMMING TREES

All drumming trees of the camera trap analysis were identified, described and photographed in the field (November 2016). Tree species were determined with the help of local people, and the local names (in Fula or Creolo) were then linked to the scientific name through an 'example tree' (marked with a specific identity number) of a phenology project which was set up earlier by Chimbo. As support we used the West Africa tree determination guide of Arbonnier M., 2004. Drumming related characteristics included divers marks of stone drumming on the outer bark of the tree (often referred to as "drumming marks", fig 1.): fresh open wounds, old open wounds, closed healed wounds, tree bump formation, large rotten spots etc. In addition the tree was often tested on 'sound production' by knocking on it with hands or stones. We also noted down if and if yes how many stones were present near the tree and if these were aggregated e.g. in piles in between buttress roots or just scattered in low densities over the ground. We also counted the amount of chimpanzee routes going into the direction of the tree (e.g. visible tracks and traces; with help of my local guide, Saca Mousa Culubali).

Within a radius of 30 m around each drumming tree equipped with a trail camera, we described the presence of other drumming trees, size and abundance of stones, chimpanzee nests and food availability (e.g. termite hills, fruits on ground, edible trees and shrubs²). In addition, all other relevant observations made during the field trips towards the different drumming sites were noted down to picture a broader area. Animal species richness was observed through trail camera analyses (see I_a activity index above).

² Trees and shrubs were considered as food source of chimpanzees if confirmed by local people and/or classified as such by previous/ongoing studies within the PanAf/ Chimbo program



Fig. 1 . Wounds on the bark of drumming trees caused by stones (also referred to as “drumming marks”). Fresh marks (A-B) growing out to ‘bigger-becoming’ closed bumps (C-D, G-I: up to 2-3 times size human head) on buttress roots of a *Ceiba petandra* tree. E: bump formation of a *Cola cordifolia* tree; and F: of an unknown tree. More open wounds or large spots of frequent harm on a *Ceiba petandra* drumming trees (J-L).

3. RESULTS

3.1 BEHAVIOURAL ANALYSIS OF CHIMPANZEE (DRUMMING) FOOTAGES

3.1.1. AICUM

We did not observe drumming behaviour. The overall chimpanzee activity is very low in Aicum.

However, once, there was a young female (“Kromhand”, with a ‘curved’ hand) who inspected the drumming tree for some seconds in July. She was traveling in the neighbourhood of a group of nine hiking adults (mostly strong males and at least one female in oestrus). “Kromhand” arrived first and climbs into the tree next to the drumming tree. After the group had passed by, she descends the tree (to inspect the trail camera – prob. a copied behaviour from one of the females of the passing group) and climbs back in the tree afterwards.

Some interesting footages:

camB14_2015.05.22_1804_H_A(1a)

camB14_2015.07.02_1133_H+R_G(3a)

camB14_2015.07.02_1134_R_G+A(1a) description of “Kromhand’s” behaviour (see above in text).

3.1.2. QUEBUBE 1

Chimpanzee activity during the period end May (30th) - end July (20th) is shown in graph 1. Drumming was observed in every period of the day, except the evening (but this might be by coincidence) and is the most frequent of all chimpanzee activities recorded. We identified ca. 5 different drumming individuals, among them: “Zilverrug”, “Krabber”, a dark strong male “Zwartman”

and one juvenile. Drumming occurs often in the following sequence of events: the chimpanzee stands on his four hands in front of the tree, wagging a bit, making soft oohoo-sounds (*u:hu:*) which becomes louder and faster. Then the chimpanzee throws one stone to the tree, and make loud screams direct after it. This behavioural sequence is most typical for drumming, and is also recorded at other sites. However, in Quebube 1 chimpanzees will often sit a long time, just before and after drumming, in front of the drumming tree, staring at it (sometimes scratching themselves, looking around and even sleeping). Stones are often carefully searched and chosen. In some cases the typical drumming behaviour stops before actually a stone is thrown to the tree. In other cases more than one stone is thrown or drumming events occur within one footage (one minute) (but mostly it is only one stone per footage), a few time this is also related with “angry” or male-like display behaviour (e.g. including tapping on chest, shaking roughly with leaves).

Some interesting footages:

CamM3_2015.06.10_1452_D(s)_A(1a)

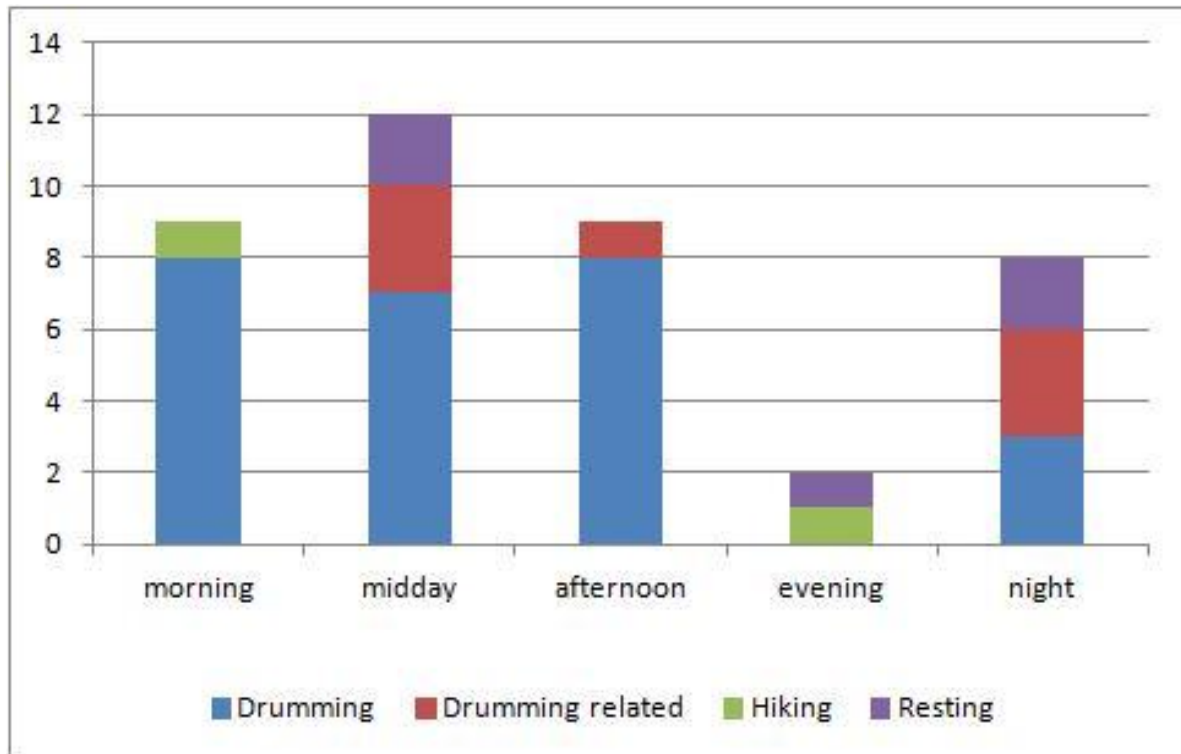
“Zilverrug” with yellowish and brownish pigmentation on his back.

camM3_2015.07.20_0346_D(s)_A(1a)

Chimpanzee searching carefully for stones, showing typical drumming behaviour (see above: wagging, oohoo-sounds, drum, screaming), then he is sitting down (typical for Quebube1). Distant ‘answer’ of other chimpanzees hearable.

camM3_2015.06.15_1251_D(s)+DR_A(1a)

2 min after drum(previous footage), chimpanzee standing still and even upward for some seconds. Not completed drum afterwards.



Graph 1. Quebube 1. Chimpanzee activity in the period end May (30st) -end July (20st).



Fig 2. Quebube1. Left: typical resting and staring at drumming tree("Zilverrug"), Right: chimpanzee sleeping.

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camM3_2015.06.23_0732_2D(3+1s)+D(distant)_A(1a)

Atypical behaviour until now. Drums more than once with different stones and even at two different trees. Big stone. Shakes roughly at bushes afterwards.

camM3_2015.07.17_0700_2D(s)_G(1a+1j)

Only once recorded until now. Juvenile and adult drumming together. Juvenile first, watching adult. Running away together.

camM3_2015.07.20_0349_D(s)_A(1a) and what follows.;

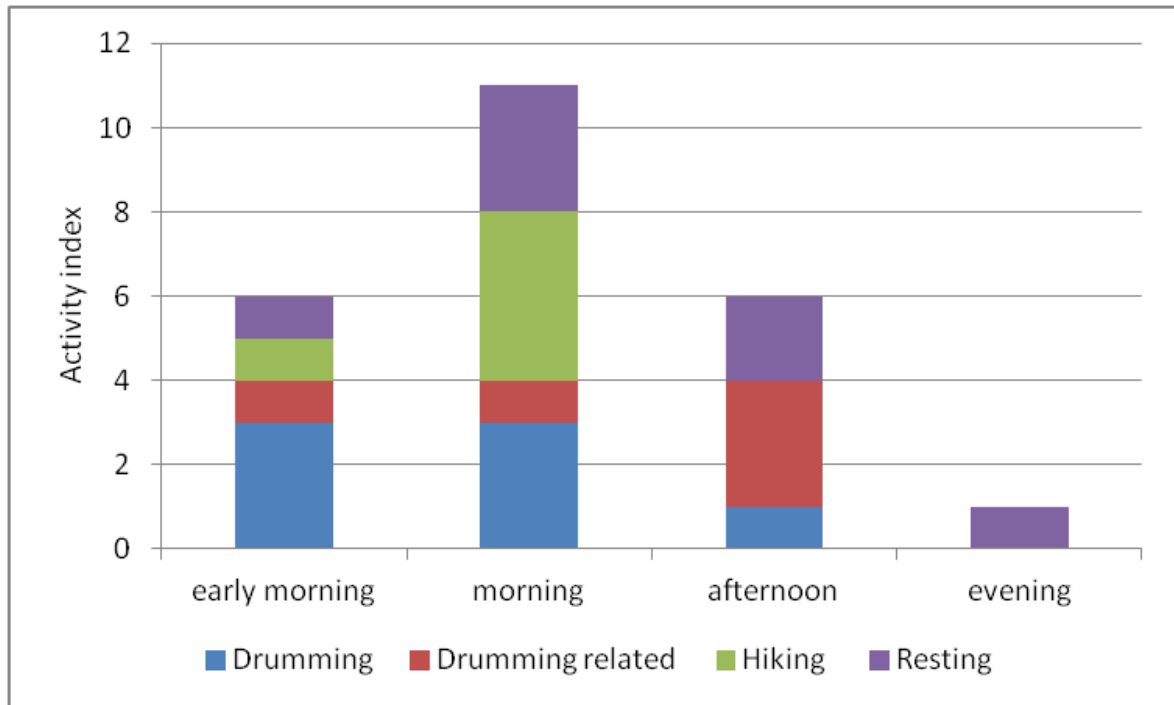
especially camM3_2015.07.20_0521_DR_A(1a) *and* camM3_2015.07.20_0523_DR_A(1a)

Very peculiar behaviour: chimpanzee drumming several times at night, acting very conscious, alert and thoughtful. Choosing stones, staring/sitting at tree, listening. Even hanging around tree and embracing it. Finally falls asleep next to tree.

3.1.3. QUEBUBE 2

We analysed only data of December and April (drumming activity during these months are shown in graph 2). Drumming did only occur in April and only in the morning. Drumming was not the most frequent observed behaviour, especially in regard to hiking and resting (behaviours which were more frequently observed in Quebube 2 than in Quebube 1). Moreover, it is possible that most (drumming) chimpanzees are the same individuals that are also recorded in Quebube 1. For example, there was an 'adult-and-juvenile' (among them 'Zilverrug') a strong dark male (possibly 'Zwartman') and a younger adult/subadult (possibly 'Krabber"). But there is still a lot of uncertainty of individual chimpanzee identity and more footages should be analysed (both on a morphological as on a behavioural and social level).

Besides this, we observed a little juvenile that jumped from the back of his mum and played/drummed with a little stone on a tree next to the main drum tree.



Graph 2. Quebube 2. Chimpanzee activity during December and April.



Fig.3. Quebube 2. Left above: drumming with feet. right above and below: juveniles playing near tree (see text).

Drumming occurred almost in the same way as in Quebube 1, although chimpanzees most often did not rest after/before in front of the drumming tree. Hence, we recorded a few times that chimpanzees drummed with their feet on the drumming tree (in absence/ after stone - drumming). Chimpanzees sometimes give some attention to the drumming tree when passing (hiking by) but often they only have a fast look at it.

Some interesting footages:

camM2_2014.12.09_1505_DR+H+G_G(2a+1sa)

2 adult chimp (male+female) pass by with juvenile. This juvenile plays near the stones of tree and will sit down on it (ca.20s).

camM2_2015.04.02_0823_D(s+f)_G(3a)

An adult or subadult watching the tree, making up-down movements and oohoo-sounds that get louder and accelerated, finally he grasps stone and rolls in from the pile away, jumps in tree and knocks with his left feet 2 times (1 loud, 1 silent) at tree bark. Jumps off tree, stays right from it (front) and looks to the distance, other chimps hearable. An elder chimp male pass by but ignores the drummer, he is followed by a female in oestrus.

camM2_2015.04.02_0838_D or DR+H_G(3a+2j)

A juvenile tries to get on the back of his mum while passing the drum. But when he sees the stones at the base of the drumming tree, he stops his game, jumps off his mothers leg and grasps a small stone, runs after his mum and knocks with his stone on the first tree he passes. After this, a female-with-juvenile-on-her-back and subadult pass by (but behind drumming tree).

camM2_2015.04.16_0632_D(s)_A(1a)

A male chimp takes a stone, steps behind (left front tree), jumps up and down, throw stone once very strongly (while defecating), jumps behind drum (left) but then stand

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directly still and comes back. After the drumming, the male comes back and sit down on the rock just in front of the tree and watch it (ca 30s), No sounds of other chimps.

camM2_2015.04.18_0809_D(s)+R_G(1a)

A male chimp takes a stone, steps back left of the drumming tree, waggling, oohoo-cries increasing and accelerating, knocks once with stone to rock on the ground in front of tree before drumming (on the bark of drum tree), and runs away. In the background another adult chimp eating, undisturbed, later 3 other adults (one female) comes and start eating (behind drumming tree).

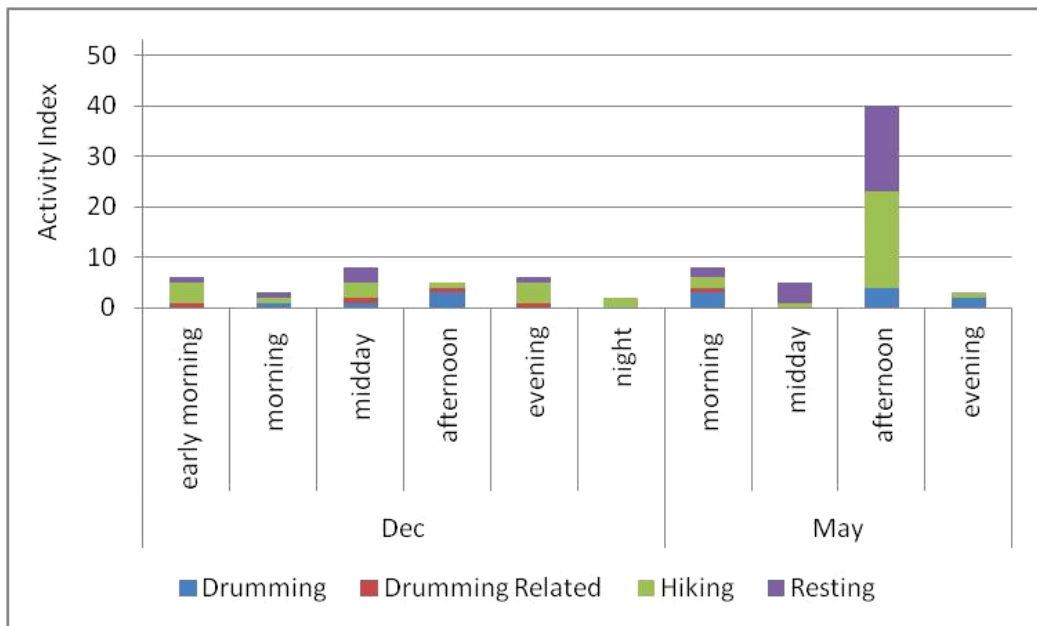
3.1.4. TONTEGE

Chimpanzee activity during the period December and May is shown in graph Drumming occurred in both months, at every moment of the day, except during the night and early morning (before 7h). Hiking was the most recorded behaviour (often recorded in combination with another type). Drummers were males, but probably also one female drummed ("Hamada"). Drumming occurs often in a typical way (as described for Quebube1), although there are some recordings when drummers are 'just' passing by (hiking or running) while they throw a stone at the tree. A few times, two drumming events were recorded in one footage.

Some interesting footages:

camG10_2014.12.13_1544_D(s)_A(1a)

"Hamada" looking at stone (aggressive/conscious) standing right from tree on root - turn round (pirouette) with loud screams, dives, takes stone and throws it (from below with left hand) at tree while standing (does not jump or runs away). Stands silent for some seconds (watching tree), examines for some time the tree and stones and sit finally at left root (ca50s)- stays whole time very silent, looks a lot a left side. At 52s



Graph 3. Tontege. Chimpanzee activity during December and May.



Fig.4. Tontege. Above: Hamada sitting on root after drumming. Below: chimpanzee drumming while almost running.

sound of distant drum?

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camG10_2014.12.18_1337_D(s)_A(1a)

"Hamada" arrives from right side, goes directly at tree, catches and throws stone while walking (left hand underhands) and making gasping short oohoo-sounds, after throw (1x) - loud screams. pirouette. Sit at left root for a while after drum (ca. 15s) (2x), cfr. camG10_2014.12.13_1544_D(s)_A(1a)

camG10_2014.12.30_1222_DR or R or H_G(2A)

big male walks slowly in front of tree, watching it and smells it (cfr. camG10_2014.12.25_0832_H+R_G(2a). Footsteps hearable, 20s later other chimp comes visible in picture

camG10_2015.05.24_1826_D(s)_A(1a)

big male adult drumming almost while walking (1x hit with stone) making almost no sound (no 'oohoo' nor cries) from right to left - after drumming footsteps hearable

camG10_2015.05.26_1018_H_A(1a)

young female in oestrus ("Witstreep") passes by and watches the tree for some seconds. Note white pigmentation.

camG10_2015.05.27_1623_2D(s)(duo)_A(2A)

drum while running right to left, 1 hit, atypical screams at end. From sec25 accelerating oohoo sound + again drum (left hand) then jumping to right - drummer stands a little bit still afterwards. A second male passes by. (! Before the drum, the accelerated oohoo-sound seemed to be made by more than 1 chimp. After drum also 'rough laughing in distant).

camM2_2014.12.09_1505_DR+H+G_G(2a+1sa)

2 adult chimp (male + female) pass by with juvenile. This juvenile plays near/on stones of tree and will sit down on it (ca.20s).

3.2. HABITAT DESCRIPTION OF DIFFERENT LOCATIONS AND THEIR DRUMMING TREES

3.2.1. AICUM

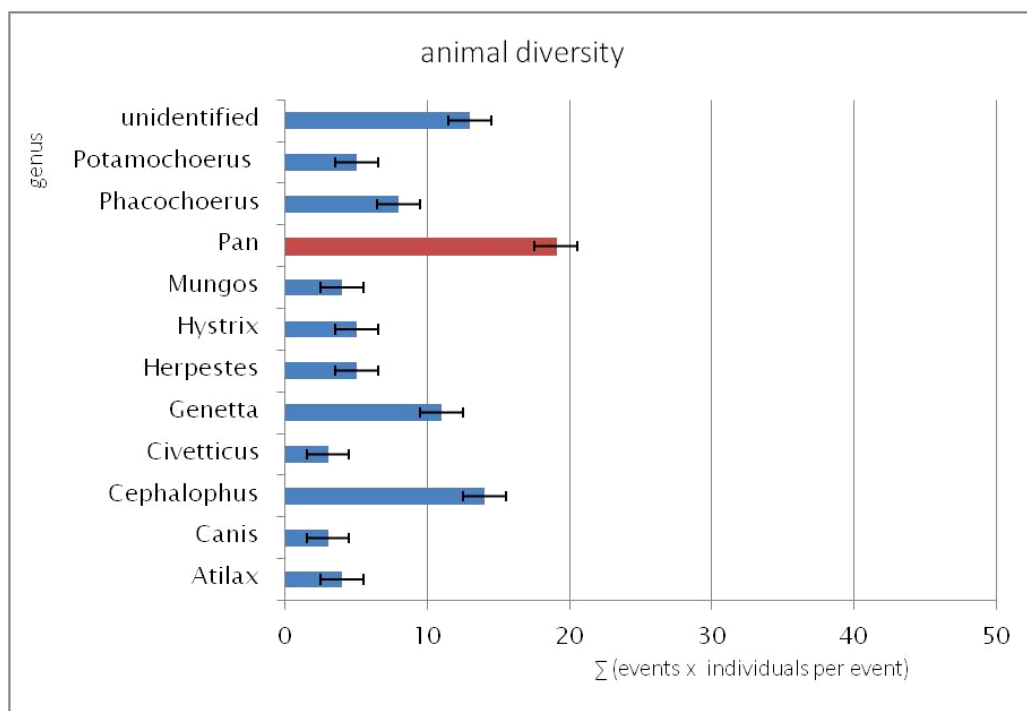
The trail camera of Aicum (B14) is positioned on a hollow drumming tree of the Combretum family (genus unknown) (fig.5). There is a large vertical opening on one side. Inside the tree, there is a pile of four big stones. Around this tree only a few more stones are spread over the ground. However, at every side of the tree, drumming marks are visible on the outer bark. The tree makes a hollow loud sound when knocking on the bark.

Within a radius of 30m around the drumming tree, we did not find any other drumming trees or chimpanzee nests. However, there was a wild trail nearby and several edible tree species: *Bombax constatum*, *Cordia pinata*, *Ficus sus*, *Hexalobus monopetalus*, *Lannea acidea*, *Parkia biglobosa*, *Pterocarpus erinaceus* and *Saba senegalensis*.

The overall vegetation has an open character with sparsely distributed trees and few bushes. During our field trip we found two other drumming trees at resp. 68m and 542 m away from the trail camera drumming tree. Those trees belonged to two other species groups: a *Cola cordifolia* and a *Parkia biglobosa* tree (no pictures available). Both trees did not seem to be used frequently (as there were only two or three marks of drumming visible on the bark and only two or three little wrist-sized stones near the tree found). Even if the *Cola cordifolia* had buttress roots, there were no piles of stones. We found only few traces and tracks of chimpanzees but heard them in the field.



Fig.5. Aicum. trail camera drumming tree and its environment. A, drumming tree main drum site front. B & D: other sides of tree; C: mountain region of Aicum



Graph 4. Aicum. Genus diversity (y-as) and activity (I_a ; x-as). Only genus levels with an I_a - value bigger than '3' are shown (overall genus richness is $S_g = 16$, see text).

The animal activity ($I_a = 389$) as estimated through the trail camera analyses was higher in comparison to Quebube ($I_a = 152$) but lower than Tontege ($I_a = 692$). Overall genus richness ($S_g = 16$) was comparable to the other locations (resp. $S_g = 16$ en 20). Chimpanzee activity ($I_a = 19$) near the drumming tree is higher than for any other species, and followed by antilopes (*Cephalophus sp.*) (Cfr. Graph 4).

3.2.2. QUEBUBE 1

The trail camera of Quebube 1 (M2) is positioned on a *Ceiba petandra* drumming tree of ca. 1.50 m width (Fig.6). There are drumming marks on every side of the trunk. Often only one big stone (eventually together with some smaller ones) is found in the open niches formed by buttress roots. In one niche there was a nest of a small bird. There is a main drumming spot (in front of tree) where more stones are gathered than at the other sides of the tree. Big rotten spots, old-grown bumps and fresh drumming marks suggest frequent use for a long time. Chimpanzee nests were only found in the directly neighbouring trees of the drumming tree. All kinds of termite nests (e.g. forest mounds, -shelter tubes, -arboreal nests and even transported broken parts from mushroom-shaped termite mounds found on the savannah) were present within the 30m radius. Other traces of food included fruit remnants near the foot of the tree and the nearby presence of many edible bushes and trees: *Bombax constatum*, *Ceiba pentandra*, *Dialium guineensis*, *Landolphia heudelotii*, *Parinari excelsa*, *Saba senegalensis*, *Sorindea juglandifolia*. There are a lot of lianas. The trail camera drumming tree is near a animal path (idem for other drumming trees in its environment, see further).

The animal activity ($I_a = 155$) recorded by the trail camera on the main drumming tree is comparable to Quebube 2 ($I_a = 149$) but much lower than

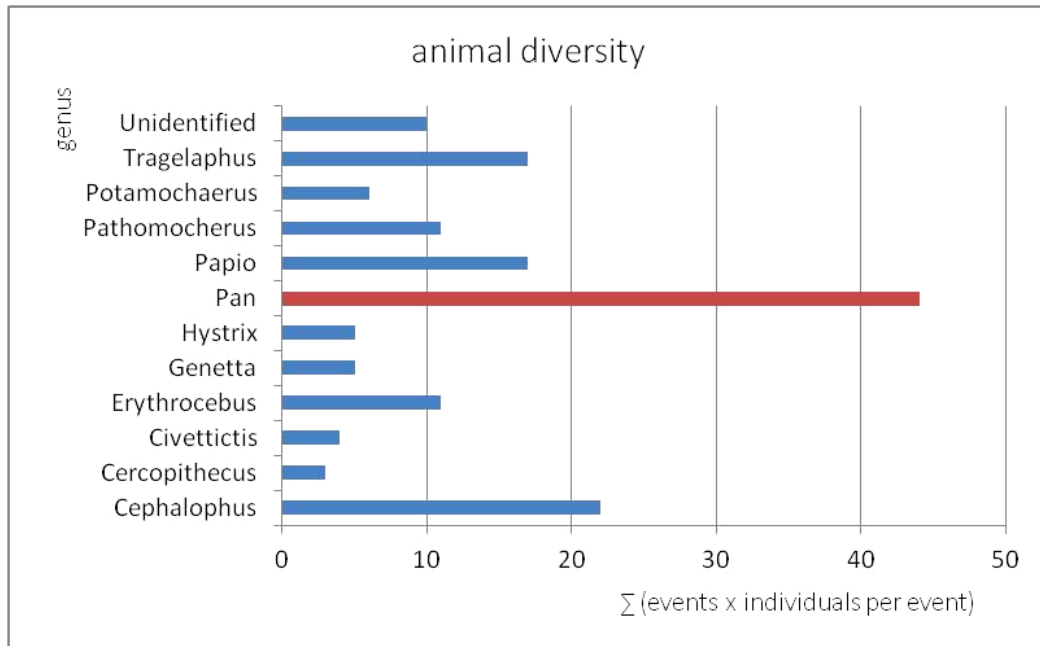
Aicum ($I_a = 389$) and Tontege ($I_a = 692$). Overall genus richness ($S_g = 20$) was comparable to the other locations (resp. $S_g = 16, 13$ en 20). Chimpanzee activity ($I_a = 44$) near the drumming tree is two times higher than any other genres. Here antilopes (*Cephalophus* sp. and *Tragelaphus* sp.) are often recorded by the camera. Also other monkeys like guinea baboons (*Papio* sp.) and patas monkeys (*Erythrocebus* sp.) are often seen near the drumming tree (resp. $I_a = 17$ and $I_a = 11$). (Cfr. graph 5).

Most other drumming trees are probably comparable to the main trail camera *C. petandra* drum tree. We found two other *C. petandra* drums at resp. 14m and 93m distance. They had similar tree morphology, drumming marks, stones and environmental characteristics, except that the latter drumming tree was slightly more hidden by a few bamboo bushes (this is within a radius of 30m). Further away ($> 30m$), near the forest edge, we found four other trees (*Pterocarpus erinaceus* and *Cola cardifolia*), but it seemed that they had only be used once or twice for drumming, with less strength or smaller stones (cfr. marks on bark).

Other remarkable drumming trees in Quebube 1 were:

- *An old drumming tree at 45m away from the trail camera (fig 7). The tree was dead, rotten and not used any more. But old drumming marks were still visible and also some drumming stones. A frequently used chimpanzee trail is still going towards it and passes under this tree (which is remarkable as this path makes an unnecessary small detour from the edge forest to this tree in the savannah and then back into the forest).*

- *A small, tall drumming tree (prob. *Spondias mombin*) at the middle of an open location, with at least twelve chimpanzee paths going towards it (fig. 8)...*



Graph 5 . Quebube 1. Genus diversity (y-as) and activity (I_a ; x-as). Only genus levels with an I_a -value bigger than three are shown. (Overall genus richness $S_G=20$, see text).

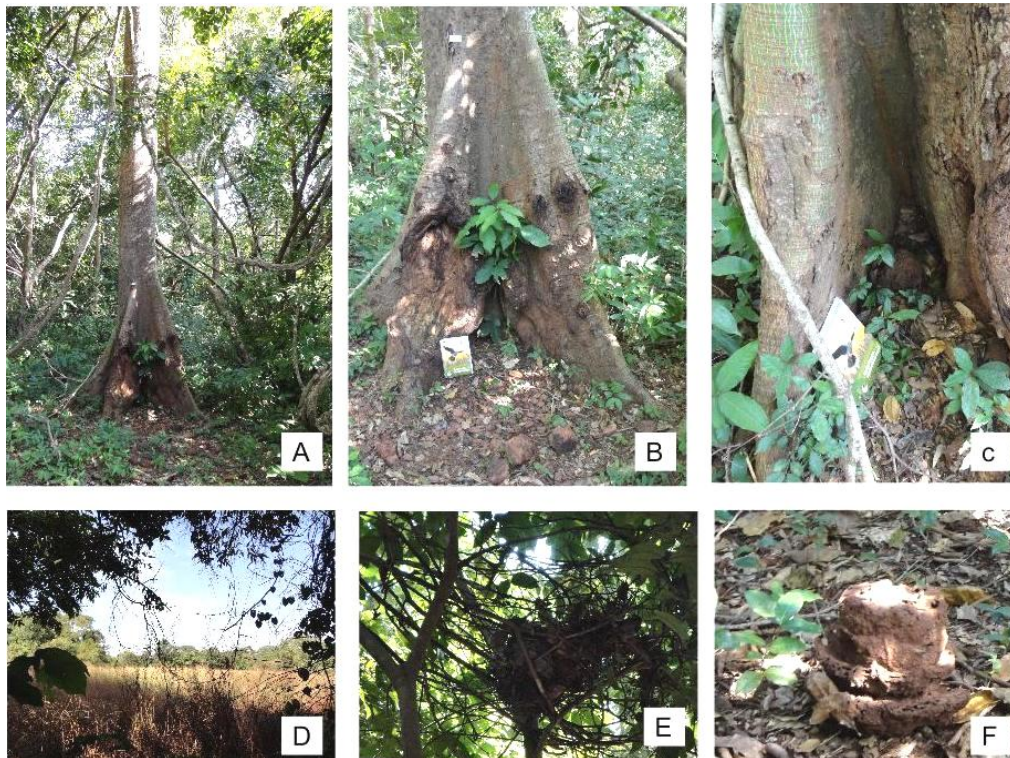


Fig.6 Quebube 1. Trail cam drum tree and its environment. A – B : front side of drumming tree: main drum spot (cfr. bast marks and stone pile –B), C: typical niche formed by buttress roots with stones, D: environment: savannah edge forest; E: chimp nest next to drum tree. F: chimpanzee food sources/ traces near drum tree, example of broken savannah termite nest, prob. brought there by chimpanzees.



Fig.7 Quebube 1. Remnants of an old, rotten drumming tree near the forest edge in the savannah. A: habitus of whole tree; B: chimpanzee path going under tree, C: close up of tree D: probably drumming stone (see text).



Fig.8 Quebube 1. Roundabout of 12 chimpanzee animal trails with in the middle a small – but frequently used- drumming tree which makes few sound when knocking on it. A: drumming tree on the right of Saca Mousa Culubali; B – E close up from drumming tree: stones (C), 'fresh' drum marks (D), 'open' wounds (E)

...Although the tree is frequently used and suffers from it (wood sap, rotten spots, drumming scars), the tree itself makes only a silent noise when knocking on it with bare hands or stones. There are marks of drumming on every side of the tree. Within a radius of 30m, most stones are located near this central drumming tree (but loose, not in piles). A few other trees had drumming marks (but only sporadically) and some chimpanzee nests (7) were found, but not directly in the neighbourhood of the main drumming tree. *Spondias mombin* is loved by chimpanzees for its round, small fruits.

3.2.3. QUEBUBE 2

The trail camera of Quebube 2 is directed towards a half-circled hollow *Pterocarpus erineaus* drumming tree (shaped by fire; Fig.9). A lot of small wrist-sized stones lay near the foot of the tree, some smashed into pieces after hitting a flat big rock laying in front of the tree. The tree is located in a small strip of savannah edge forest (ca. 20 m wide), near a chimpanzee trail. Within a radius of 30m, there are many lianas, but few termite traces, or chimpanzee nests. The amount and diversity of feeding trees is comparable to Quebube 1. In addition, we found another *P. erineaus* drumming tree (ca.10 m away) but with only few drumming marks and no stones close to it. *P. erineaus* is called 'Po di sang' in Kriol, which refers to the red wood sap which becomes visible after chimpanzees pile the bark for feeding (incl. in fig. 9) (S.M. Culubali, pers.com).

The animal activity ($I_a = 149$) recorded by the trail camera towards the main drumming tree is comparable to Quebube 1 ($I_a = 155$) but much lower than Aicum ($I_a = 389$) and Tontege ($I_a = 692$). Overall genus richness ($S_g = 13$) was lower but comparable to other locations (resp. $S_g = 16, 19$ en 20). Chimpanzee

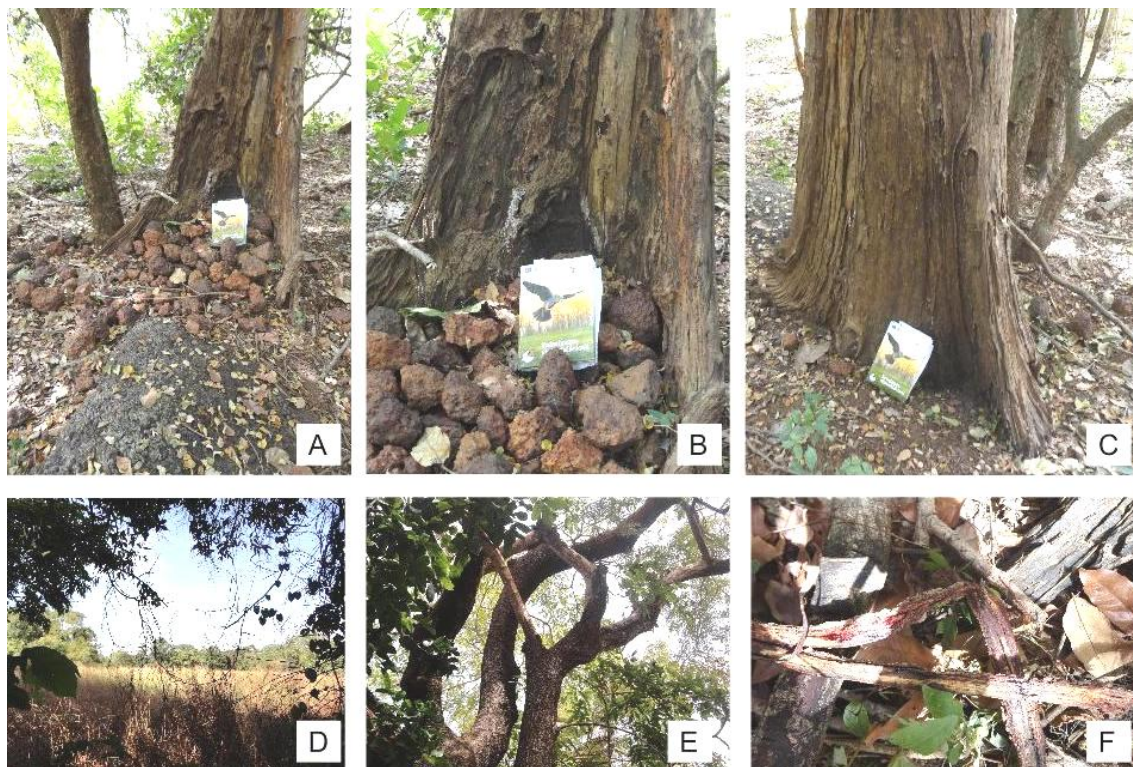
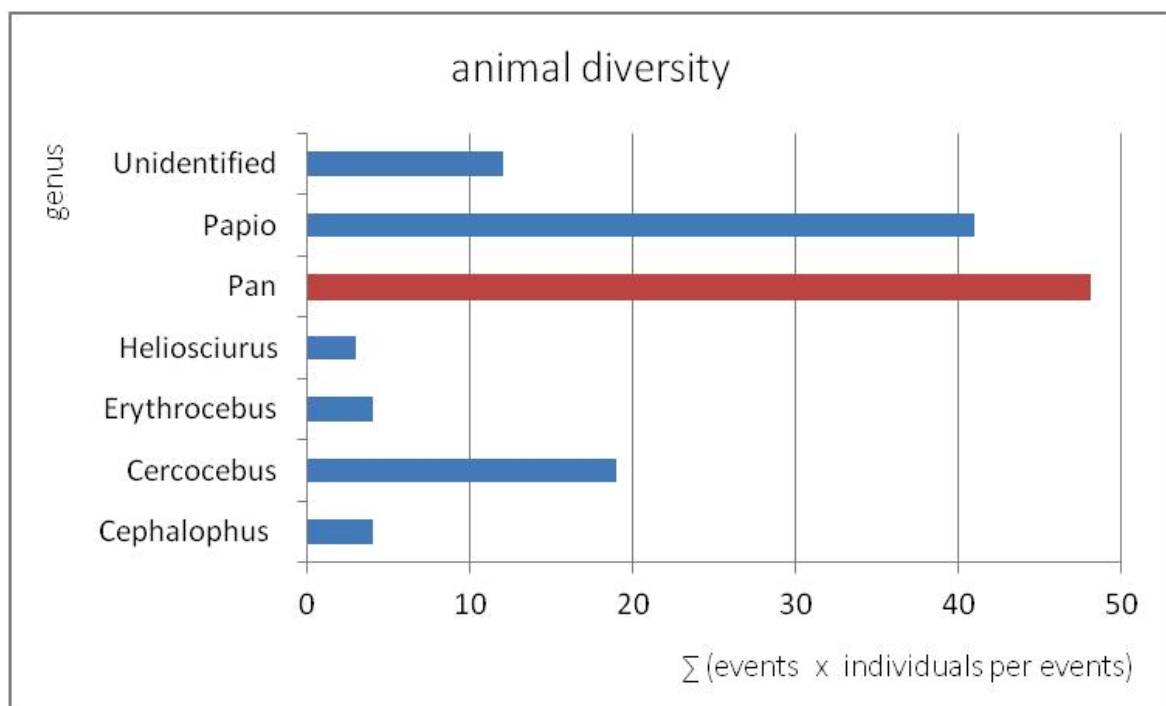


Fig 9. Quebube 2. Trail cam drumming tree (A-C, note the flat rock in front) and environment (D: savannah edge forest; E-F piled bark of an *P. erinaus* by chimpanzees (food source) .



Graph 6. Quebube 2 Genus diversity (y-as) and activity (I_a ; x-as). Only genus levels with an I_a -value bigger than three are shown. (Overall genus richness $S_G=16$, see text)

activity ($I_a = 48$) near the drumming tree is comparable to Quebube 1 ($I_a = 44$). However, not very different from the activity of guinea baboons (*Papio papio* $I_a = 41$). Sooty mangabeys are also present (*Cercobus atys*, $I_a = 19$). The activity of antilopes (*Cephalophus* sp. and others) is much lower. (Cfr. graph. 6.).

3.2.4. TONTEGE

The drumming tree which was observed with the trail camera was a big, dead hollow tree (*Kaya senegalensis*?) and produced a loud, low sound when knocking on it with bare hands or stones (fig.10). A pile of stones lay in between buttress roots in the front (slightly half circle form of tree). Drumming marks and stones are visible at every side of the tree, although most were in the front. This drumming tree stands in the bottom of a gallery-forest depression, just near a small murmuring brook. There are some chimpanzee paths coming towards this tree and chimpanzee nests are present only in the direct neighbourhood of the tree (ca. 5). Feeding trees included *Afzelia africana*, *Landolphia heudelotii*, *Saba senegalensis*, *Sorindea juglandifolia*. A bee nest was present in a distant tree. There was a big wooden log in the water near the drum tree which might function as a bridge.

The animal activity ($I_a = 1354$) recorded by the trail camera is much higher than Quebube or Aicum (resp. $I_a = 150$, $I_a = 389$). Probably due to a high activity of chimpanzees ($I_a = 277$), and sooty mangabeys (*Cercobus atys* $I_a = 247$). Overall genus richness ($S_g = 16$) was comparable to the other locations (resp. $S_g = 18$ en 20).

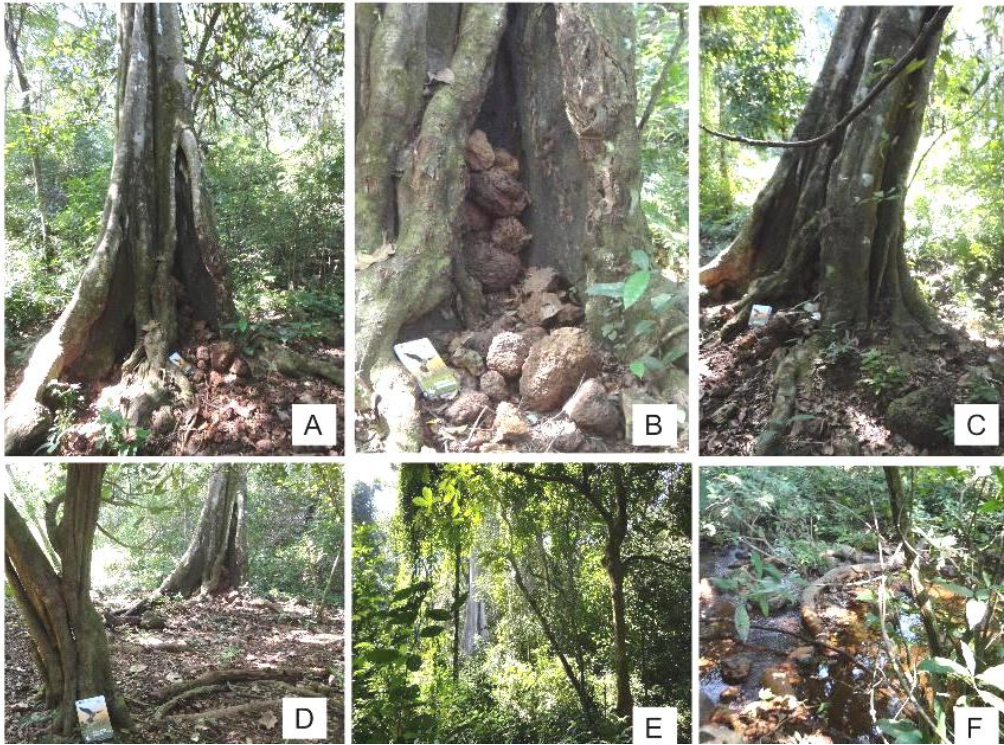
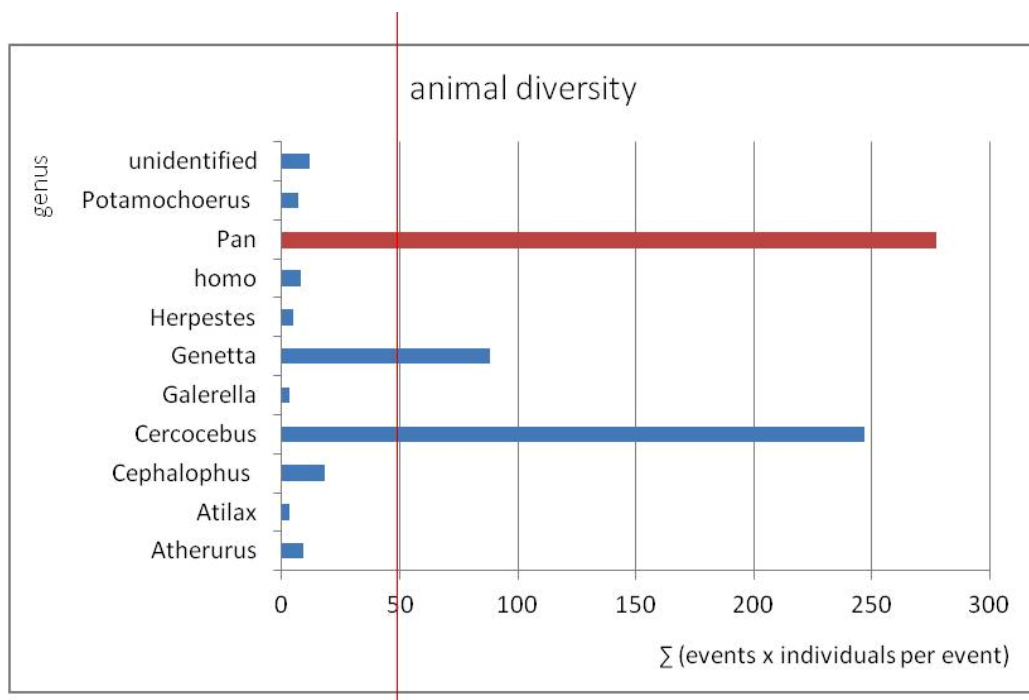


Fig 10. Tontege Drumming tree (A-C) and environment (sacred gallery forest, D-E). A-B front drumming tree (note big buttress root left from tree), D: first drumming tree next to it, E: gallery forest with cathedral drum, F: murmuring brook.



Graph 7. Tontege. Genus diversity (y-as) and activity (I_a ; x-as). Only genus levels with an I_a bigger than three are shown. (Note scale difference in scale in comparison to previous graphs.)

*Very remarkable at Tontege, is the high density of other drumming trees within the 30m radius around the trail camera drum tree. In total we found 13 other drumming trees, most of them only sporadically used (only 2-3 drumming marks all round, few/no small sized stones). The other trees were no drumming trees (feeding trees or other, ca. 8) or possible-but-not-sure drumming trees (ca. 5). Particular drumming trees were a 'baby drum', a 'Cathedral drum' and a 'two part drum'. The baby drum, prob. *Cola cordifolia*, was a young and small tree with at the bottom some very small stones (100-200g) and drumming marks close to the ground. The sound, however, was remarkable for such a small tree. The other drum, the 'Cathedral drum' was a typical, big and frequently used *Ceiba petandra* drum (see below). We did not find a high density of other drumming trees within a 30m radius around this more impressive cathedral drum in comparison to the trail camera drumming tree. And lastly, the 'two part drum' consisted of two small trees, which were positioned so close to each other, that a drumming stone hit both trees at once (through rebounding). This tree was not frequently used.*

The trail camera drumming tree and its close environment (this is within a 30m radius) was a unique example in comparison to the other types of drumming trees found in the gallery forest of Tontege. Main drumming types in Tontege were:

*- 'Tarba drum' (fig.11): *Cola cordifolia*. Only used as drum tree when direct located near a used chimpanzee path. (A similar tree which stands only 3 m apart will not show drumming marks if it is not close to the path). Mostly some stones are present, but often loosely spread on the ground and not in piles. Drumming marks on the bark are especially at the site of the path, never at the opposite site. In a few cases there are nests in the neighbourhood, but never in the trees direct near the drum tree. Once we found 3 nests in a Tarba drum, but this was in a tree which was a direct neighbour of a Cathedral drum (see below). The density of this type of drumming tree is relatively high. *C. cordifolia* also grows at the edge of the forest and can be used as*

food source by chimpanzees. Sound when knocking on bast: loud.

- 'Cathedral drum' (fig 12). *Ceiba petandra*. Massive kapok tree in the middle of the sacred gallery forest. Appears to be important for chimpanzees. Frequently used for a long time. Old drumming bumps may get big sizes (ca. 30 cm or more). Drumming marks at every side of the tree. Big stones (3,5 -5 kg), often in piles in between buttress roots. Nest of chimpanzees in neighbouring trees (for e.g. 10).

In addition, we found one drumming tree which was neither a 'cathedral' nor a 'tarba' drum. This *Treculia africana* drumming tree was located on a rock in the middle of a brook. However, there were only few drumming marks visible. There were some chimpanzee nests and feeding trees in the neighbourhood.

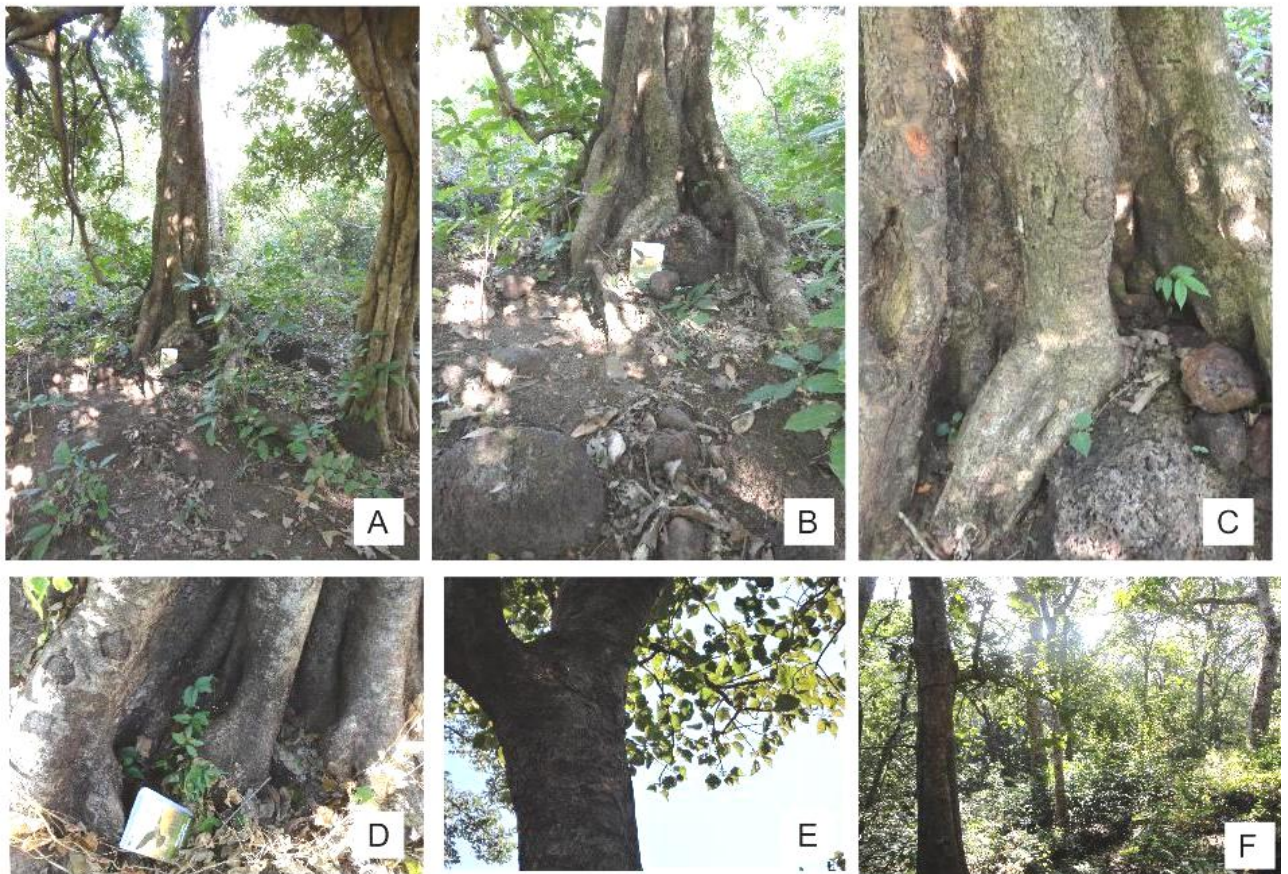


Fig 11. Tontege. 'Tarba' drums (*Cola cordifolia*). A-B: habitus, note niches formed by buttress roots (also C), C: red drumming spot, D: closed drumming wounds, E: leaves tree; F: sacred gallery forest, not far from the edge.



Fig 8. Tontege ‘Cathedral’ drums (kapok tree, *Ceiba petandra*) in the sacred forest. A: habitus of tree, B-D: buttress roots with stones; C: drumming marks on buttress roots?; E- F stones and marks; G-H tree bumps on buttress root caused by drumming; I habitus of tree; J-K: sacred gallery forest.

4. SUMMARY AND DISCUSSION

4.1. IS DRUMMING DIFFERENT AT DIFFERENT LOCATIONS?

Not enough data have been analysed to make firm statements. The differences in behaviour observed (see results) might be caused by individual variation, rather than location or chimpanzee group. It is unknown if the three groups of chimpanzees (resp. Aicum, Quebube and Tontege) are related to each other. Drumming behaviour often occurred in the same order: a chimpanzee standing on his knuckles in front of the tree, watching it, wagging a bit, starting to make soft 'oohoo'-sounds which get louder and accelerated, grasp a stone, standing up, throw it at the tree, directly followed by one or two loud screams (fig. 9). In Quebube, the chimpanzees often sit a long time in front of the tree (or next to it), looking at the tree, before and after drumming. In Tontege, this sometimes happens as well, but not so pronounced, and chimpanzees sometimes just drum while walking/ running/ passing by the tree. In Aicum, we did not observe drumming during the research period. Too few data are also available to assess the time (month, day, hour) when drumming mostly occur.



Fig. 9. Typical manner of drumming (see text).

Location, however, did seem to have some effect on drumming behaviour as a consequence of different habitat type, tree and chimpanzee density (although yet without statistical evidence) (see table 3). In sparsely populated chimpanzee areas, with wandering and hiking chimpanzees (like the mountain area of Aicum) the abundance and use of drumming trees seems to be much lower than in areas with a higher and permanent chimpanzee activity (like the sacred gallery forest of Tontege). In addition, in Aicum, there are many dead trees, wooden logs (chimpanzee might drum on them with bare hands), and stones spread all over the ground making the use of drumming trees probably less important. Only three drumming trees were found in Aicum: rather far away from each other, belonging to different family groups, and two only sporadically used. On the contrary, in Tontege, a much more complex and divers habitat with less stones (meaning more effort needed to gather stones), only some tree species were used for drumming but in higher densities (cfr. the difference between ‘*tarba*’ and ‘*cathedral*’ drums which might have other functions – see below). Interesting is Quebube, a location with characteristics situated somewhere in the middle of the two other locations, Aicum and Tontege (both regarding environmental as well as chimpanzee and drumming related characteristics), where often one main type of drumming tree was present.

Drumming trees are probably selected for sound quality (e.g. *C. cordifolia*), but also prob. for wound healing (cfr. appendix), splinters (local perspective) and resistance to savannah fire (e.g. *P. erineaus*). Most main drumming trees were surrounded by edible trees and shrubs. Lianas, small neighbouring trees, a rock or large (buttress) roots seem to be used by chimpanzees to climb into (when passing by), grasp/jump on (while drumming) or to rest upon (before and after drumming had taken place).

Table 3a. Differences in location and drumming tree (related) characteristics.

	Aicum	Quebube 1	Quebube 2	Tontege
Habitat type	mountain area	savannah edge forest	savannah edge forest	gallery forest
Human disturbance	low	moderate	moderate	low
Overall species activity (I_A) compared to chimpanzee activity	high	moderate	moderate	low
Stones present at location, on the ground, useful for drumming	high + wood logs	moderate	moderate	low
Edible trees, bushes and other feeding signs	moderate	high	high	low-moderate
Actual drum tree density (trees with marks of repeated drumming)	low	moderate	moderate	high
Drum tree diversity (on an expected functional level)	low	moderate	moderate	high
Drum tree diversity (on species level)	high	low One main type <i>C. petandra</i>	low One main type <i>P. erinaus</i>	moderate <i>two main types: 'tarba' vs 'cathedral drum'</i>
Chimpanzee activity I_A	low	moderate	moderate	high
Chimpanzee nest distance to drum tree	> 30 m away	Next to main type, not to others	Next to main type, not to others	Next to cathedral drum, not to tarba drum

Table 3b. Drum tree species

	Aicum	Quebube 1	Quebube 2	Tontege
Trail camera drum tree	<i>Combretum sp.</i>	<i>Ceiba petandra</i>	<i>Pterocarpus erinaeus</i>	? <i>Kaya senegalensis</i>
Other drum trees	<i>Cola cordifolia</i> <i>Parkia biglobosia</i> ...	<i>Cola cordifolia</i> <i>P. erinaus</i>	<i>C. petandra</i>	<i>C. petandra</i> <i>C. cordifolia.</i> ...

4.2. SOME HYPOTHESES

4.2.1. THE ORIGIN OF DRUMMING

Several hypotheses have been developed for the origin of chimpanzee drumming. Some local people claim that the first drumming-with-stones might be the consequence from a random action, a ‘music making noise’, a male display behaviour or as communication tool (the latter claimed by Amadal Camará). Some others (like Alfa Iaia Queita) say that chimpanzee just throw stones to chase away dangerous animals like serpents (which could be hidden inside tree holes) and that stone piles accumulated by accident (as the last stone may fall on the previous one – as I did indeed once observe through trail cam analysis).

4.2.2. COMMUNICATION

Chimpanzees might use drumming trees for long distance communication. However, the study design was inadequate to investigate this hypothesis in detail (see below). A few times we heard screams - and even once stone drumming in the distance – after a drumming event had taken place. In a lot of cases, it seemed that the chimpanzee was carefully listening, - or waiting- after a stone was thrown away. We do not have enough data yet to determine the triggers that initiate drumming (feedback or response mechanism).

Sometimes stones are carefully chosen and a sequence of behavioural (ritual) traits fulfilled (see further)– but other times the drummer is just drumming while passing or running by.

Although a lot of drumming trees are probably selected for their sound-making capacities like the ‘tarba’ (*C. cordifolia*) and ‘cathedral’ (*C. petandra*) drums; we found a frequently used drumming tree that made hardly any sound when knocking on it (fig. 8, p. 24-26).

4.2.3. MALE DISPLAY BEHAVIOUR

Another hypothesis is that males throw big rocks to trees (while screaming loudly) to overawe other males or to impress females. However, drumming often take place without any spectators in the neighbourhood (except for Capebonde where drumming sometimes occurred within a family group, pers. observ.); although the design of this study might not have been sufficient to observe other watching/hearing individuals (see further research). It is remarkable that sometimes also small stones are selected for drumming. Only once, we observed a strong furious male drumming on several trees, screaming, shaking bushes and even beating his chest (fig. 10).

In addition, a female (“Hamada”) was observed to drum frequently (e.g. fig. 11); and also juveniles seems to be interested in drumming (see above, and at Capebonde, pers. observ.). Fig. 12 shows a juvenile and an adult drumming together.



Fig. 10. "Zwartman" shaking furious with bushes and beating his chest after drumming



Fig. 11. "Hamada" (right and left above) a female drummer with "Witstreep" (left below).



Fig. 12. Adult “Zilverrug” and a juvenile, drumming together with stones and then running away (first the juvenile is drumming than adult).

4.2.4. ‘RITUAL-CULT-CULTURAL’ HYPOTHESIS

This hypothesis, together with the last one, is probably the most likely. How could one otherwise explain that chimpanzees will come for several times (prob. even generations) to the same drumming tree and not to another, even if an almost identical tree is standing just a few meters away from it? Why else would they sit a long time before the tree, watching it, before and after drumming? Repeating the same serial of behavioural drumming traits, and even building their nests around it?

Crucial in this hypothesis is the observation of the chimpanzee “Krabber” which came in the night, to drum, hugging the tree and finally falling asleep in front of it (fig. 13a, 13b). Some young females have been recorded several times near the drumming tree with some interest in it, although they did not drum (cfr. “Witstreep” in Tontege and “Kromhand” in Aicum – see descriptions results).

Sometimes, stones are carefully chosen before drumming, and drumming itself seems to occur in a series of behavioural events which are sometimes ceased or interrupted by some displacement activities³ (Tinbergen and Kortlandt, 1940) like scratching .



Fig 13a. “Krabber” hugging the drum tree at night (see text).

³ *'displacement activities occur when an animal experiences high motivation for two conflicting behaviours (e.g. to flee away or to attack), the resulting displacement is usually unrelated to the competing motivations (scratching, eating...), (cited from Wikipedia) '*

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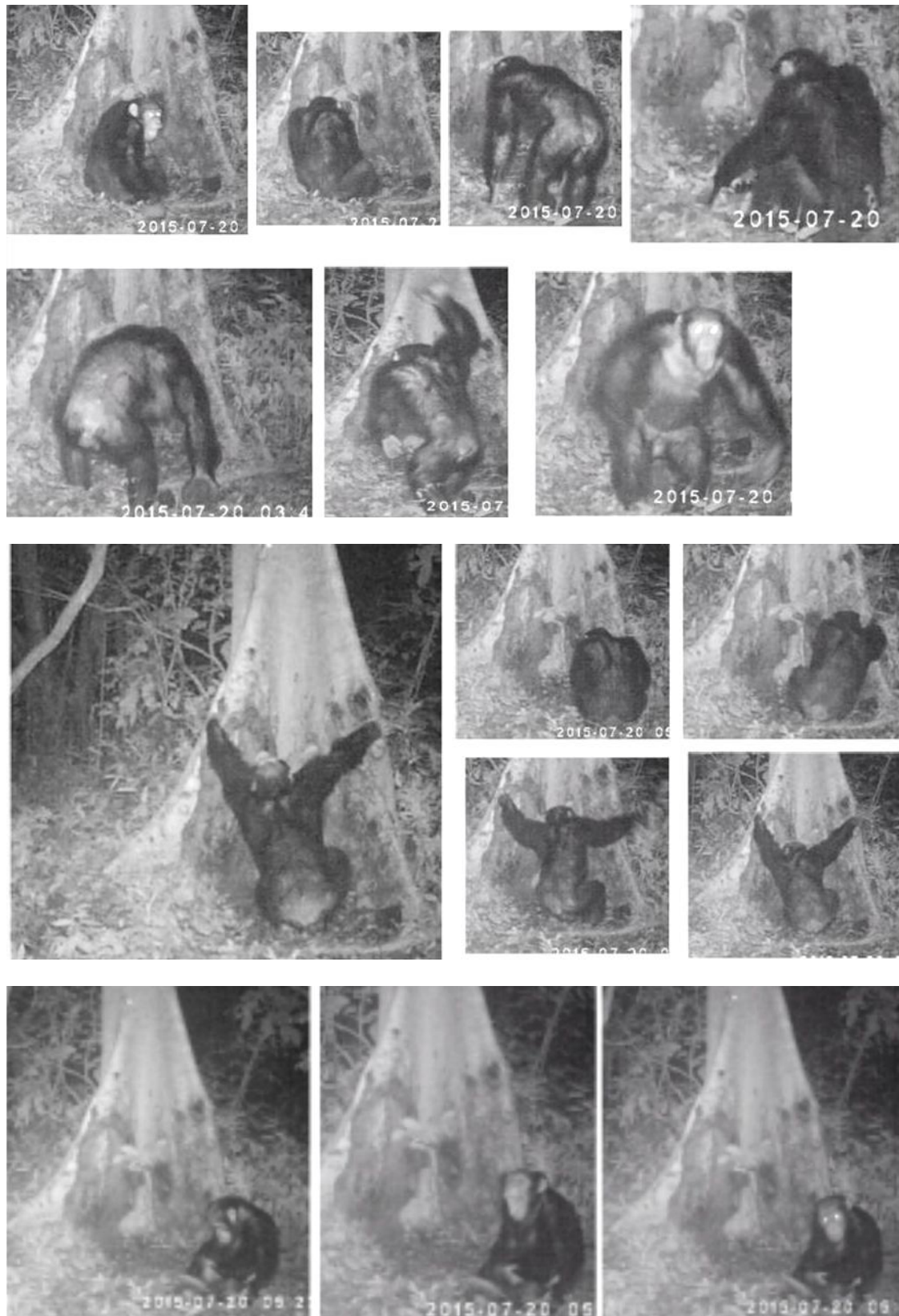


Fig. 13 b. “Krabber” carefully searching for a stone, drumming, making a pirouette ...then coming back later to hug the tree in the middle of the night...and finally falls asleep.

4.2.5. 'MUSIC' OR 'JUST-LIKE-THAT' HYPOTHESIS

Chimpanzees may drum because they like it, for music or another reason.

4.2.6. THE 'OF-EVERYTHING-A-BIT' AND 'OTHER' HYPOTHESES

Until now, for every hypothesis we found arguments pro and contra, so there might be a truth in all of them. The function of drumming might be dependent on location and type of drumming tree. For example, in Tontege, the smaller '*tarba*' drums near the chimpanzee road might be used for communication; while the '*cathedral*' drums might have a more 'ritual' function. And sometimes drumming might have several reasons at once (e.g. a male adult chimpanzee might show his strength and high position by drumming for another reason).

It is also quite possible that chimpanzees use stone drumming trees for another purpose than here described, a reason which we might never fully understand.

For example, to mark their territory. In Tontege, tarba drums are near the animal paths, and we made an observation of an old (abandoned?) and rotten drumming tree where still a used chimpanzee trail was going towards, even though it made a small detour outside the forest back into the savannah (fig. 7, p. 24-26). In addition, we have some recordings of chimpanzees smelling at something near the drumming tree (although such observations are rather rare for the moment).

4.3. FUTURE RESEARCH

Not only from a scientific viewpoint, but also for the chimpanzees themselves, it is important not to disturb them if not necessary in order not to influence their behaviour. Therefore, monitoring should be non-invasive and as infrequent as possible, especially at the sites of the

drumming trees. Trail cameras are a good option, but chimpanzees are aware of them (visible through camera records), and researchers should do an effort to be silent, hidden and quick during fieldwork).

This pilot study was not sufficient to investigate a difference in drumming behaviour between different locations, groups and individuals; or to test different hypotheses. Therefore the study should include other designs, specific adapted to each hypothesis. For example, to investigate whether drumming characteristics differ *among* locations, variation *within* each location should be known as well as the relation of the different (sometimes wandering) chimpanzee groups. In addition it would be interesting to see and/or hear the response of other chimpanzees provoked by drumming events (e.g. through additional cameras, and longer sound recordings) to investigate the ‘communication-’ or ‘male display-’ hypotheses more in detail. Furthermore, research should be done on a longer time span, and one should know if the same drumming tree is used by chimpanzees over generations (through non-invasive wound healing studies of wood or by queries with local people, see appendix).

5.PIGMENTATION OF CHIMPANZEES

During this study, we observed large parts of white, yellowish and pale brown pigments in the fur of adult and juvenile chimpanzees (male and females). We do not know if this is a rare observation or not, since we did not find anything about it in the literature yet. Pigmentation included large spots and stripes on the back and extremities (e.g. limbs), but also smaller dots on faces and bare skin (although the latter is a more common characteristic). Individuals with pale pigmentation were recorded at every location of this study (Aicum, Quebube, Tontege) and Capebonde (pers. observ) in the Boé.

The percentage of pale-pigmented chimpanzees in the total population is still

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hard to estimate, and pale pigmentation might be confounded by other factors like light impression, bare skin and dirt.

Some examples (with no or very few confounding):

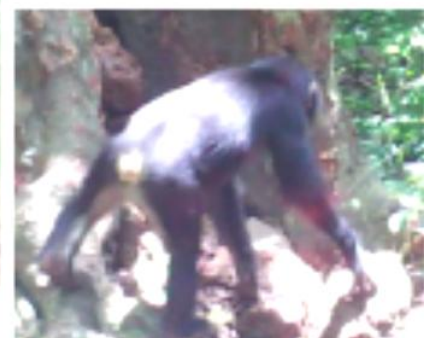
Aicum (prob. 2 different individuals).



Quebube ("Zilverrug"):



Tontege ("Witstreep"):



Capebonde (“Gele broek”):



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7. ACKNOWLEDGEMENT

I thank especially my guide and teacher Saka Mousa Kulabali, but also Alfa and Kali for help in the field; and Djoulde for her warm welcome in Africa. This pilot study was investigated voluntarily for the Chimbo Foundation, Guinea Bissau and would not have been performed without the help of A. Goedmakers and P. Wit. In addition, I would like to thank the Milvus Group, Romania, to enhance my way of thinking.



Saka Mousa (with blue vest) and I drinking tea in front of Djoulde's house (Djoulde with writing table) in the evening.

8. APPENDIX

8.2. “The sound of Distant Drums” – interview with local people

8.3. Wound generation of drumming trees- Can we measure age?

8.4. Trail Cam Pictures of drumming behaviour

8.4.1. AICUM

8.4.2. QUEBUBE 1

8.4.3. QUEBUBE 2

8.4.4. TONTEGE

8.2. "THE SOUND OF DISTANT DRUMS" – INTERVIEW WITH SOME LOCAL PEOPLE

The sound of distant drums

Interview with some local people on different aspects of stone-drumming of chimpanzees

Project: Chimbo organization, The Netherlands

Names:

Bartelijn Buys, biologist, interviewer, Belgium

Saca Mousa Culabali, guide, Béli, the Boé, Guinea Bissau

Amadal Camara, guide, Béli, the Boé, Guinea Bissau

Alfa Iaia Queita, chauffeur-mécanicien... et translator, Bissau, Guinea Bissau

Location : Béli, the Boé, Guinea Bissau

Date : 06/12/2015

Language: French, Creole et Fula.

Some footage of trail cameras, directed towards drumming trees, was shown before the interview started (see table below). These trail cams included both footages of chimpanzee behaviour (drumming and other) as well as some other animal species which were trapped with the camera's near those specific drumming trees.

1. HYPOTHESES

1.1. Bartelijn : "Does someone know why drumming trees exist?"

Amadal: For the traditional community, those drumming trees are regarded as a way of communication between animals, especially chimpanzees. They are like blacksmiths, so in that way chimpanzees resemble humans. And vice versa. So humans are not allowed to hunt chimpanzees, even to disturb them.

Bartelijn: *"But Saca Mousa and I, found a location within the middle a small tree (see picture) with signs of frequent and hard drumming. There were at least twelve chimpanzee's roads leading to this tree. But the tree itself did not give a big sound when we knocked on it with our hands, and even with stones. So drumming trees are maybe not only used for communication?"*

Amadal: "There were probably no other good trees available for drumming in that environment."

Bartelijn: "No that is not true. We found other trees in the neighbourhood that had much more sound when drummed on it. And some of them were of the same tree species where we already found drumming signs on in other locations, like the "Tarba" tree (*Cola cordifolia*). "

Amadal (ignoring my answer). "They choose very specific trees for drumming to avoid splinters when hitting trees with rocks. If a splinter gets into your eye, you might get blind."

1.2. Bartelijn: "But can't it be that they drum with stones on the trees to show their force?" (display-behaviour)

Amadal, Alpha and Saca Mousa: "Yes, to show their force to females. Males are the superiors of the family. It are the males that drum"

Bartelijn: "But on some footages I watched juveniles and sub adult males who showed some kind of drumming behaviour. Sometimes they were chased away by adult males for that. And in the field, we found a little, small tree with some little rocks and small marks of drumming near the ground (see picture). This little drumming tree is located just near an important old drumming tree which is frequently used by adults."

Amadal: "Trees, like the "Tarba" tree, are recognized for their sound, even when these trees are still in a very young stage."

1.3. Bartelijn: "Do you think they drum to communicate to God or other ghosts? Is it something spiritual?"

Amadal: "They also make these gesture as a way of making fun. In day and night time."

Amadal: "One day, I was with a hunter from/in Guinea Conakry (Guinea). He wanted to kill a female chimpanzee with a little baby. But at the moment he wanted to shoot the female, it looked if she prayed to God. So the hunter did not kill her."

1.4. Note: origin of drumming behaviour?

Some days before this interview I asked Alfa why drumming trees existed. I hadn't show him footages of the trail camera yet. He laughed and said: "They throw stones on the tree to chase away dangerous animals like serpents." - And I answered: "But sometimes there are really piles of stones near or inside these trees. Don't you think that's bizarre?" - He laughed again and said: "that's just because the last stone that is thrown will fall on the previous one".

Even if Alfa's theory is difficult to find evidence for (on footages) I think this might be a possible trigger for the origin and evolution of drumming trees. It also came up into my mind when I did my first research on drumming trees. I did never observe a dangerous animal fleeing away from the tree trunk after this was forcedly hit with a stone, but I did observe a big stone falling on the previous one after it was thrown by a chimpanzee.

2. LOCATION and ENVIRONMENT

2.1. Bartelijn: *"Do you know a place where there are a lot of drumming trees?"*

Amadal: "Tontege."

2.2 Bartelijn: *"I would like to know in which environments drumming trees are found. Have you ever seen drumming trees in...?" (questionnaire via pictures)*

*a) the middle of the savannah?
space."*

Amadal: "No, never in open

*b) in small forest fragments like Quebube?
chutes de les*

Amadal: "Yes, mostly on "les
collines", plateau's and rivers.

c) in a small oase with palm trees (sound)?

Amadal: "No".

Saca Mousa: "No, but they use palm trees as food
source."

d) in the mountains?

Amadal: "Oui, Aicum"

e) within/ very close to a village?

Amadal: “No, but it is possible if the drumming tree was there before the village was built.”

2.3. Bartelijn: *“Are there often chimpanzee nests visible round the drumming trees?”*

Amadal: “Yes, almost always.”

2.4. Bartelijn: *“In which environment are the most chimpanzees present: Aicum, Tontege or Quebube?”*

Amadal: “The most chimpanzees occur in Tontege, then in Quebube and few in Aicum. Chimpanzees are often there where also human settlements are (e.g. use of food sources). They are rare in very wild environments (“une brousse perdu”) like Aicum, most chimpanzees there are only travelers to search for food.”

2.5. Bartelijn: *“Are drumming trees sometimes situated in environments which risk to be burned in yearly savannah fires?”*

Amadal: “No, drumming trees are often on spots where savannah fires are not so violent, Therefore it is not such a big problem if slash-and-burn practices are started early in the year (October-December).”

3. THE SOUND OF distant drums

3.1. Bartelijn: *“Do you sometimes hear the drums of the chimpanzees?”*

Amadal: “Yes, even from a long distance. Sometimes you hear also the chimpanzees yelling. But sometimes only drumming.”

3.2. Bartelijn: *“How many times do you hear them hit the trees per event?”*

Amadal: “Always more than one time.”

Bartelijn: *“In which season do you hear the drums?”*

Amadal: “They drum the most in the beginning of the dry season.”

3.4. Bartelijn: *“At which time of the day do you hear them drum?”*

Amadal: “They drum the most when the night is falling or the sun is rising. They need a sign when they go to bed or wake up. It are the adults who do that.”

4. The USE of STONES and DEATH WOOD

4.1. Bartelijn: “Do they always use the same kind of stones for drumming?”

Amadal: “Yes, but the sizes of the stones differ. They are sometimes very big and often lay in piles near the tree.”

4.2. Bartelijn: “Do they sometimes use dead wooden logs laying on the ground nearby for drumming?”

Amadal: “Yes it is common. And there are often used stones near it.”

Kali. and Saca Mousa told me the same in the field, and showed me some dead logs during our field trip in Aicum.

Remarks:

The interviews were meant to be a sort of discussion between Alfa, Saca Mousa, Amadal and me. I was curious both about their cultural perception towards chimpanzee drumming behaviour, as well as their excellent knowledge of the brousse. However, it was almost always Amadal who took the parole, while Saca Mousa remained silent most of the time. Even if I explicitly asked for his opinion. Most of the time he said that he agreed with Amadal. Unfortunately it was Saca Mousa, and not Amadal who was most of the time in the field with me (while I was doing the research) and not Amadal. It appeared to me that Saca Mousa learned quickly what I was doing (e.g. looking for drumming marks on trees, the sound they produced, traces and tracks, their environment). He started to look also carefully at things, making comparisons and checking again. Even if we looked at those trees which did not really appear to be drumming trees at the first sight (and mostly were not), or e.g. if it was very hard to find chimpanzee nest in the dense vegetation. I am almost sure that he must have been aware that the answers of Amadal were not always supported by our fieldwork of the last two weeks. I think that he was only silent during this research as respect for Amadal, an elderly man. Amadal was calm and sure. He did not always think carefully about my questions, sometimes ignoring them. Maybe he was also influenced by some footages of chimpanzee behaviour on the start of this interview. During the whole interview, he never watched me (a girl), only Alfa.

8.3. WOUND GENERATION OF DRUMMING TREES- CAN WE MEASURE AGE?

Box. wound regeneration of tropical trees – how old are some drumming marks?

With the help of dr. *Claire Delvaux*

Service of Wood Biology

Royal Museum for Central Africa

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Phone: [+32\(0\)2.769.56.12](tel:+3227695612)

It is difficult to estimate for how long the same tree has been used for stone drumming by chimpanzees by only morphological descriptions and photographs of the wounds present on the trees. Information on the time a tree has been used might be crucial to classify this behaviour on a cultural scale, if it appears that the same tree is used by more than one generation of chimpanzees. However, wound generation speed and formation is a process which depends on many factors such as tree species, health, life strategy (e.g. pioneer or colonist), ground type, age and season. It is important to know where the wound is made (e.g. trunk, buttress root, north or south direction), in which manner (e.g. strength, object) and if tree health is affected by it. Some trees are capable to form a 'wound barrier' (e.g. recovery of bark, bump formation) to impede the invasion of pathogens into the tree; while other trees show poor recovery and don't close the wounds (e.g. *Azela africana*) but might have other mechanisms to avoid pathogen invasion (e.g. only anatomical features such as compartmentalization and callus formation). After the wound is closed it might open again and new wound tissue might be formed. Also the frequentation and rate of drumming might have an influence on wound regeneration.

Most *Ceiba petandra* and *Cola cordifolia* drumming trees are capable to form bumps (protuberances of tree overgrown with bark) as response on stone drumming by chimpanzees (fig). This relatively healthy recovery mechanism of the tree might play a role in the choice of type of drumming tree species. (It might be a disadvantage for the chimpanzee when a tree dies as a consequence of drumming).

Research on the age and 'health' of tree bumps or other drumming marks can be investigated by making trans sectional wood discs, which will reveal anatomical features such as vessel density, compartmentalization, 'age rings' and frequentation of events that a stone has hit a particular spot on the bark. (Cfr. Delvaux 2010).

However the sampling of wood discs for anatomically analysis is a strong invasive method. And should only be used on experimental wounded trees, other than the specimens that are used by chimpanzees for drumming. The age of drumming marks and wound tissue might be determined by tracing bump formation and speed of fresh made drumming marks. Therefore the growth and regeneration of such drumming marks should be monitored at least every two months (described and measured), especially during the growth season, for some years. With this information, the age of old-grown big bumps can then be calculated.

Further reading:

Delvaux *et al.* 2010. Wound reaction after bark harvesting: microscopic and macroscopic phenomena in ten medicinal tree species (Benin). *Trees (Springer)*.

Note:

Cfr. Interview with local people: trees might also be selected for having few splinters when drumming on it (dangerous for your eye).

Also the knowledge of local people (investigated through semi-qualitative interviews) might teach us if the same drumming tree is used over different chimpanzee generations.

8.4. Trail Cam Pictures on drumming behaviour

8.4. TRAIL CAM PICTURES OF DRUMMING BEHAVIOUR

8.4.1. AICUM

8.4.2. QUEBUBE 1

8.4.3. QUEBUBE 2

8.4.4. TONTEGE

Cam B14

Drumming tree of Aicum

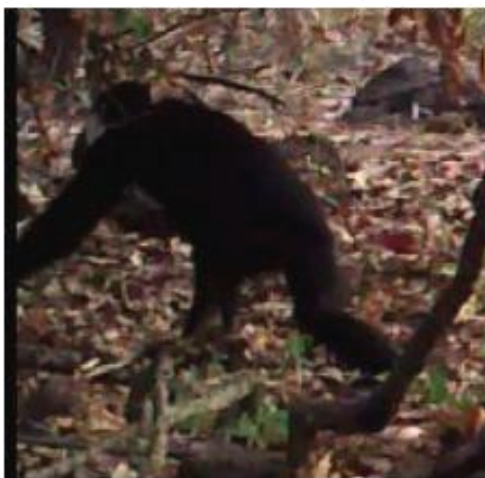
APRIL/ MAY



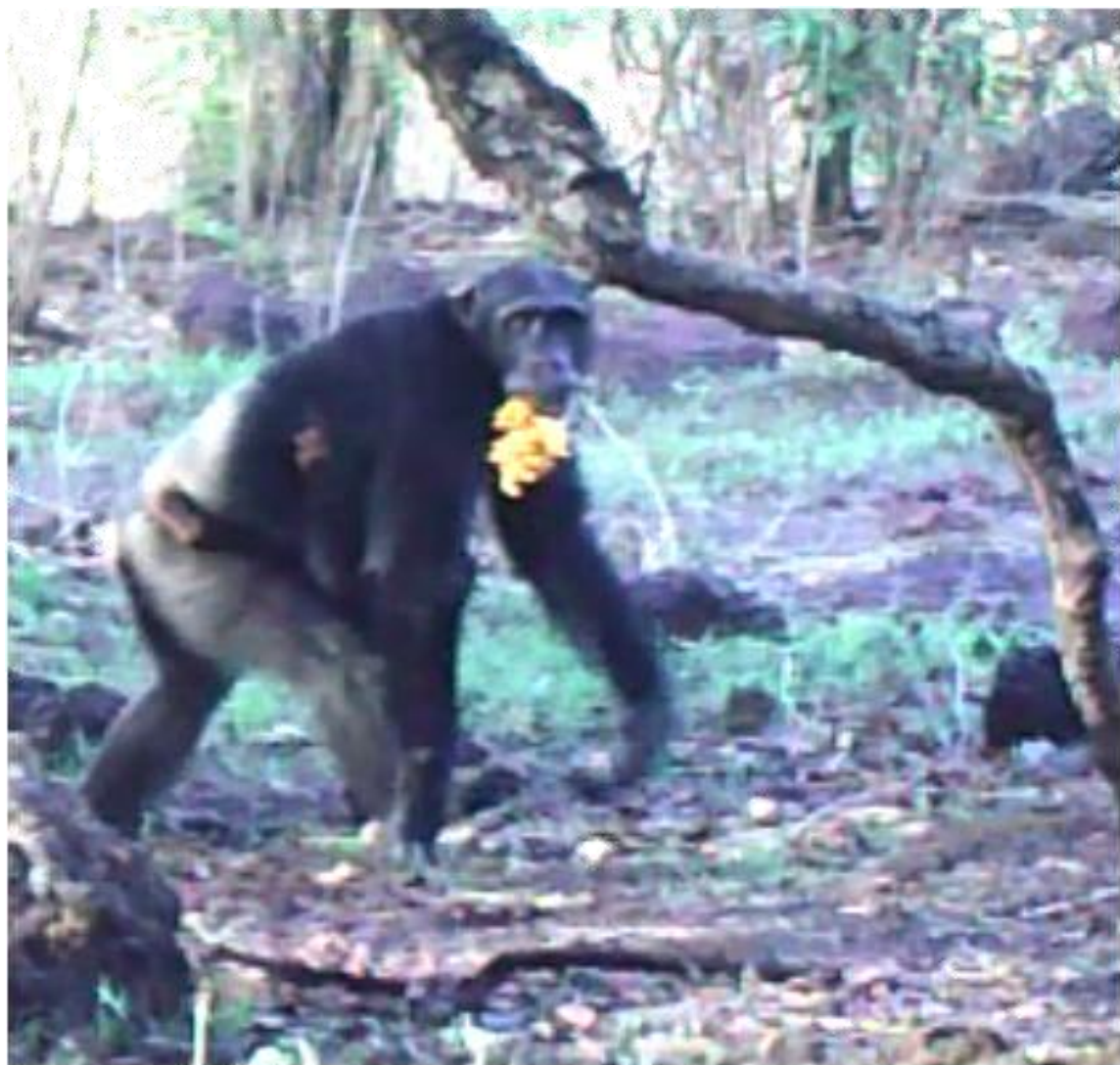
camB14_2015.04.11_0739_H_G(2a)



camB14_2015.04.14_0632_H_A(1a+1j)



camB14_2015.04.16_0724_H_G(1a+1j)

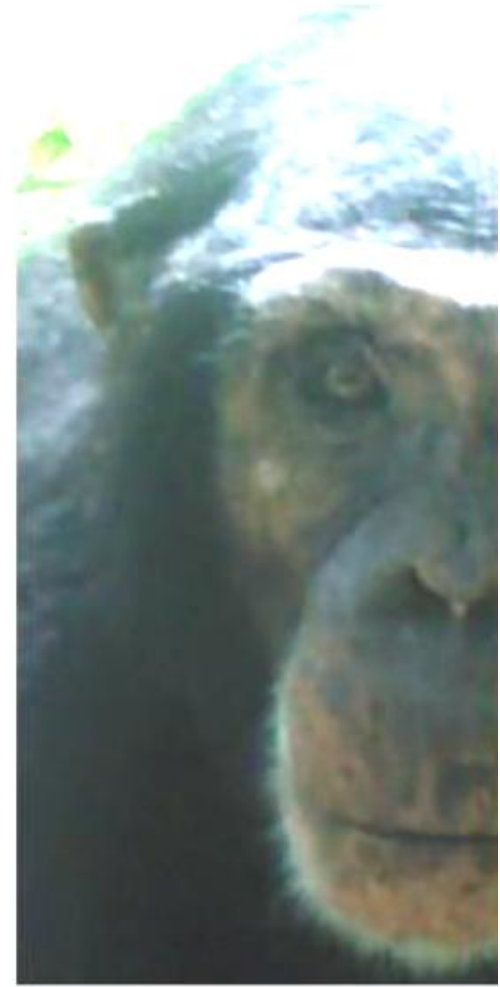


camB14_2015.05.22_1804_H_A(1a+1j)

JULY

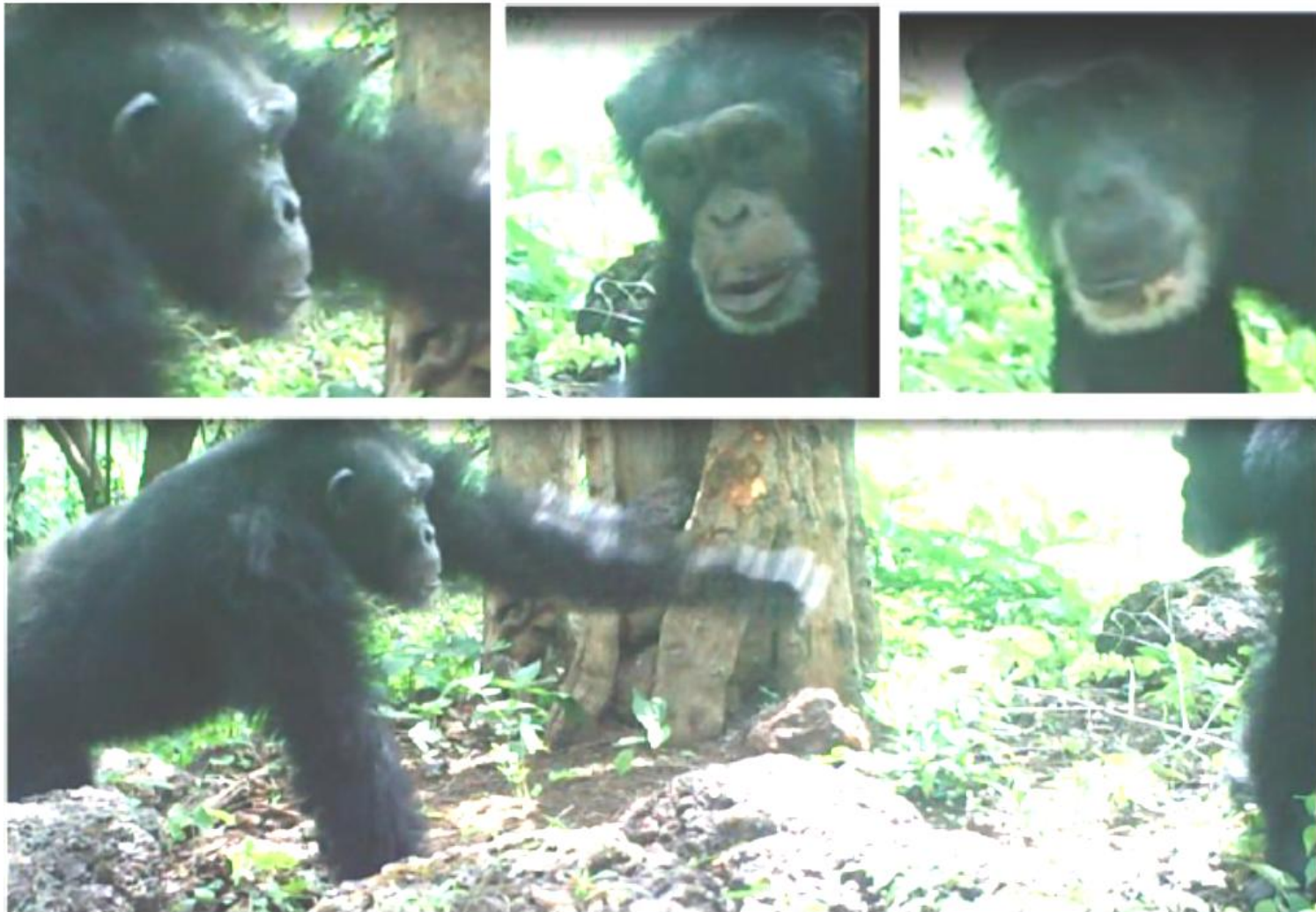


camB14_2015.07.02_0932-34 ev...Kromhand, alone, investigates drum tree and climbs in itree



"Groepsvrouwtje" in trekkende 'mannetjesgroep', onderzoekt camera, witte vlek op kaak

CamB14-2015.07.02_1133-34



"Mannetjesgroep"

Enkele duidelijke koppen van apen in deze groep (meest duidelijk kernmerk is lichte vlek op lip). Onderaan mogelijks leider
CamB14_2015.07.02_0933-34

Cam M3

Drumming tree of Quebube 1

11

MAY / JUNE



camM3_2015.05.31_1358_DR(s)_A(1a)A/V1 VLC Media Player



zilverrug en krabber?

camM3_2015.06.10_1114_D(s)_A(1a)A/V1



Zilverrug en Krabber? above: camM3_2015.05.31_1358_DR(s)_A(1a); below: camM3_2015.06.10_1114_D(s)_A(1a)



Krabber?

imM3_2015.06.10_1358_2D(s)_A(1a).A



amM3_2015.06.10_1400_D(2s)_A(1a).AVI - VI

Zwartman



Zilverrug



Krabber?





Zilverrug

amM3_2015.06.15_1338_2D(s) +D(distant) + DR_A(1a).AVI - VLC Media Player



Zilverrug and juvenile? drumming together, juvenile first then running away

amM3_2015.07.17_0700_2D(s_G(1a+1j).AVI - VLC Media Player



Krabber

camM3_2015.07.20_0346_D(s)_A(1a).AVI - VLC Media Player

kra



Krabber

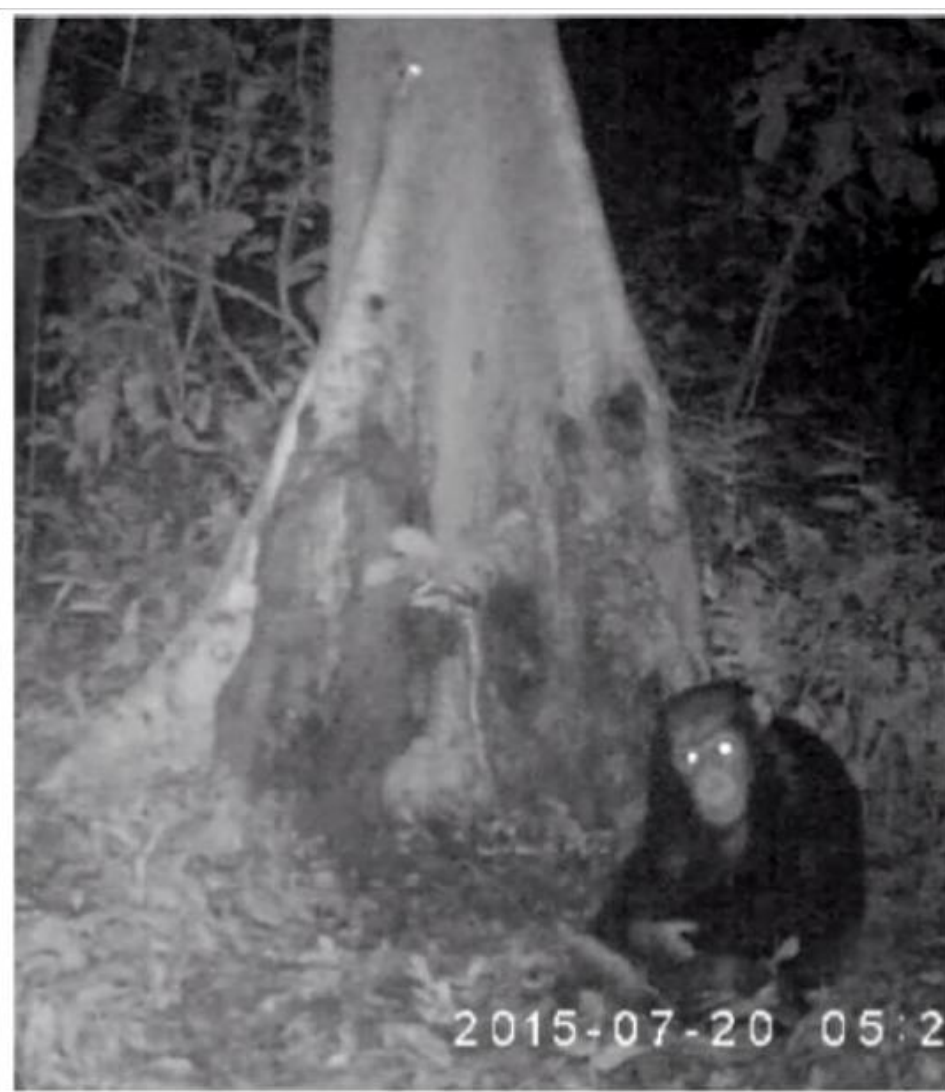


camM3_2015.07.20_0521_DR_A(1a)



Krabber

camM3_2015.07.20_0523_DR_A(1a).AVI - VLC Media Player



Krabber

camM3_2015.07.20_0523_DR_A(1a).AVI - VLC Media Player



Zwartman shaking furious bushes while drumming



camM3_2015.06.23_0732_2D(3+1s)+D(distant)_A(1a).AVI - VLC Media Player

Zilverrug?



camM3_2015.07.12_D(s)_A(1a).AVI - VLC Media Player
id3 Afspelen Audio Video Extra Weergave Help

zwartman?

Cam M2

Drumming tree of Quebube 2

11

December



amM2_2014.12.09_1505_DR+H+G(2a+1sa).AVI - VLC Media Player

amM2_2014.12.09_1505_DR+H+G(2a+1sa).AVI - VLC Media Player



camM2_2014.12.09_1703_H_G(2a+1sa) (2).AVI - VLC Media Player



camM2_2014.12.09_1711_H_G(2a+1sa) (2).AVI - VLC Media Player

above: camM2_2014.12.09_1703_H_G(2a+1sa) (2).AVI -

&

under: camM2_2014.12.09_1711_H_G(2a+1sa) (2).AVI - VLC Media Player



camM2_2014.12.15_1454_R_G(1sa+) (2).avi Media Player



camM2_2014.12.29_1805_R_A(1sa) (2).avi Media Player

above: camM2_2014.12.15_1454_R_G(1sa+) (2).

& under: camM2_2014.12.29_1805_R_A(1sa)

APRIL



Alone

camB14 -2015.04.02-08.13



camM2_2015.04.02_0819_H+R_G(3a+1).AVI - VLC

camM2_2015.04.02_0819_H+R_G(3a+1).AVI - VLC Media Player



Jong volwassen mannetje, duwt eerst steen weg van hoop, klimt en drumt 2x met voet
 blijft even rechts van boom staan, mannetje en vrouwtje passeren

camM2_2015.04.02_0823_D(s+f)_G(3a)

camM2_2015.04.02_0823_D(s+f)_G(3a)



drummer







"little one" drums with stone on tree next to drum tree
hiking group (another adult with juvenile on back, and a
juvenile/subadult



amM2_2015.04.05_0608_D(s)_A(1a).AVI - VLC Media Player



Possible drummer
camB14_2015.04.13_0858_H+R_G(1a+1sa)



Volgorde van drum verloop: pakt steen, springt op en neer, werpt, staat even naast boom, gaat dan heel lang voor boom zitten

Opm. Poept tijdens drumming, as-storm

camB14_2015.04.16_0632





Verloop van drumming (zei vorige slide, maar hier snelt hij direct weg
Cam B14_2015.04.16_0635_



Volgorde drumming

Wiegt eerst heen en weer, slaat met steen op rots, dan op boom, holt weg
op achtergrond ongestoord vrouwtje- later komen er nog twee chimpanzees bij
CamB14_2015.04.18_0846

Cam G10

Drumming tree of Tontege

December



CamG10_2014.12.12_0920_D(s)_A(1a/sa)



CamG10_2014.12.12_1412_D(?) + D(distant) + H_G(2a+j+?)
Drum sound at distant



CamG10_2014.12.12_0920_D(s)_A(1a/sa)

CamG10_2014.12.12_0920_D(s)_A(1a/sa)



camG10-2014.12.12_1732_DR_R_A(1a)
"Hamada" ?



hamada

camG10_2014.12.13_1544_D(s)_A(1a)



(CamG10_2014.12.18_1337_D(s)_A(1a)
; Hamada



camG10_2014.12.24_1403_D(s)_A(1a)⁽¹³⁾

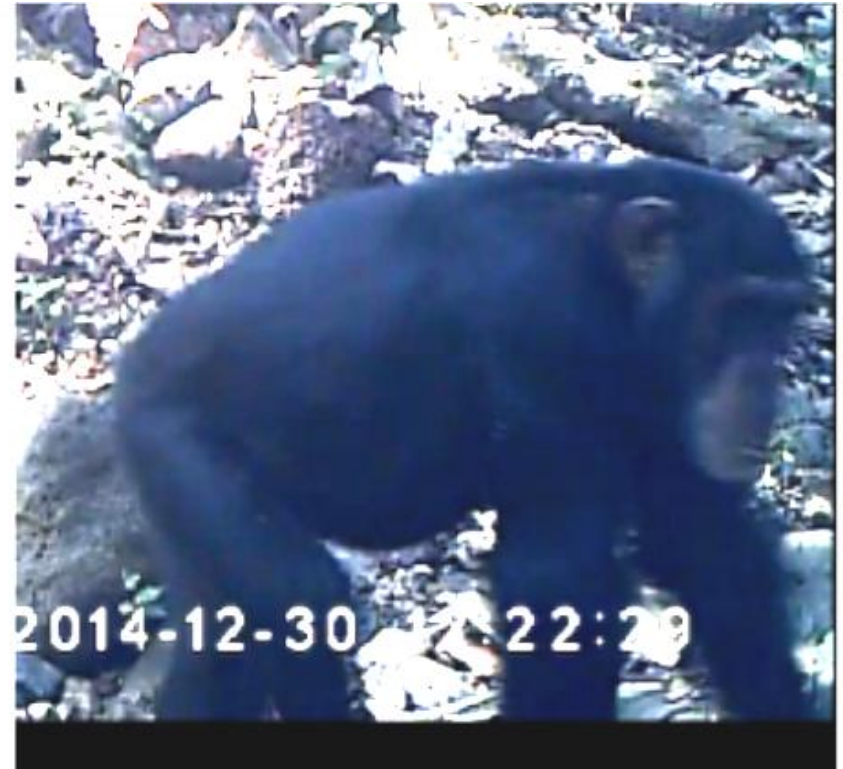
"klein dik mannetje"





camG10_2014.12.25_0832_H+R_G(2a)

Who? Hamada and "klein dik mannetje"? prob not



camG10_2014.12.30_DR ?+H+R_G(2a-

Smelling? Cfr. Dia above

MAY / JULY



camG10_2015.05.24_1826_D(s)_A(1a)

Very fast, first 5 seconds recorded. Stands up, grasping tree with one hand, jumps on -and then off- left root

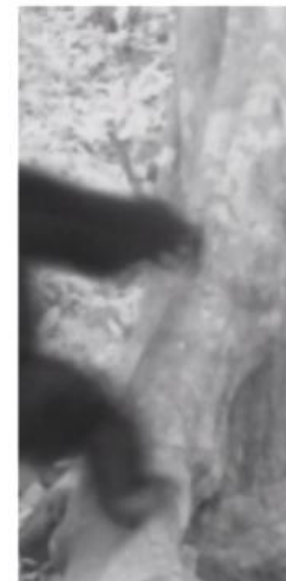
"Vasthouder"



camG10_2015.05.24_1843_D(s)_G()

Very fast, first 5 seconds recorded. Stands up, grasping tree with one hand, jumps on - and then off- left root

"Vasthouder"





"witstreep"

CamG10_2015.05.26_1018_H_A(1a+1j?)



camG10_2015.05.26_1041_2D(s)_A(1a)

2x drum, at the beginning and at the end of the footage, prob. more than one individual

Last drummer has a lot of characteristics of previous -"vasthouder?"

White pigmentation possible, but difficult too see bc of light





camG10_2015.05.26_1058 EN 59

stands still for a very long time in front of tree. Jumps up from squat. White stripes on arms and legs - but probably because of light and hairless spots. Blg fat male

Z



camG10_2015.05.26_1315

Hamada



Hamada (right and right above) smelling at same spot as before & Witstreep (left under), smelling



camG10_2015.05.26_1514



CamG10_2015.05.27_1632
while running

