WILDLIFE AND SPIRITUAL KNOWLEDGE AT THE EDGE OF PROTECTED AREAS: RAISING ANOTHER VOICE IN CONSERVATION

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Wildlife and spiritual knowledge at the edge of protected areas: raising another voice in conservation

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ABSTRACT

International guidelines recommend the integration of local communities within protected areas management as a means to improve conservation efforts. However, local management plans rarely consider communities knowledge about wildlife and their traditions to promote biodiversity conservation. In the Sebitoli area of Kibale National Park, Uganda, the contact of local communities with wildlife has been strictly limited at least since the establishment of the park in 1993. The park has not develop programs, outside of touristic sites, to promote local traditions, knowledge, and beliefs in order to link neighboring community members to nature. To investigate such links, we used a combination of semi-directed interviews and participative observations (N= 31) with three communities. While human and wildlife territories are legally disjointed, results show that traditional wildlife and spiritual related knowledge trespasses them and the contact with nature is maintained though practice, culture, and imagination. More than 66% of the people we interviewed have wild animals as totems, and continue to use plants to medicate, cook, or build. Five spirits structure human-wildlife relationships at specific sacred sites. However, this knowledge varies as a function of the location of local communities and the sacred sites. A better integration of local wildlife-friendly knowledge into management plans may revive communities' connectedness to nature, motivate conservation behaviors, and promote biodiversity conservation.

Keywords: Chimpanzee; Kibale National Park; Local Communities; Spirits; Totems; Uganda; Wildlife

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INTRODUCTION

African protected areas (PAs) are mainly administered by non-governmental organizations (NGOs) or governmental departments, and local communities are only remotely involved in the writing of conservation management plans (Bennett et al. 2017). Success in national parks conservation has been suggested to be linked to education, awareness, and outreach programs to the communities neighbouring parks (Muhumuza and Balkwill 2013) or promotion of tourism activities (Archabald and Naughton-Treves 2001). However, Mugisha and Jacobson (2004) showed that conservation successes did not differ between Ugandan PAs with and without community-based conservation programs.

Traditional societies often have extensive biodiversity and ecological knowledge and maintain a deep connection to nature (Descola 2005; Friedberg 1997; Gadgil et al. 1993; Kohn 2013) through social and religious values, which were previously strong enough to make people obey environmental regulations. For example, clans, totems, and taboos played a significant role in biodiversity conservation by restricting human access to some places or species (Gorjestani 2004) through a variety of norms, practices, and beliefs (Attuquayefio and Gyampoh 2010; Dagba et al. 2013; Friedberg 2014; Ghanashyam Niroula and Singh 2015; Holmes et al. 2017; Infield 2001; Klepeis et al. 2016; Koponen 1988; Rim-Rukeh et al. 2013). Also, taboos often protect sacred groves which results in the protection of plants (Mgumia and Oba 2003); forest loss is less important in forest considered sacred (Byers et al. 2001); and hunting taboos allow wildlife population to increase (Saj et al. 2006). As a result, wildlife species that are regarded as sacred prosper (Dagba et al. 2013) and are often denser in areas where they were protected by traditional knowledge (Ntiamoa-Baidu 2008).

As the world's biodiversity loss is increasing (Ceballos et al. 2017), it is important to provide additional means to reduce threats. This is particularly the case at the highly populated edges of PAs, where wild plant and animal species collection is restricted or prohibited, as this may increase a cultural or psychological distance with wildlife, while people are suffering from wildlife's damage on their property, such as crop feeding. In this context, conservation programs should consider including positive local values and wildlife beliefs to reinforce the connection between people and nature to promote positive conservation behavior (Tam et al. 2013; Zylstra et al. 2014).

Here, we focus on Kibale National Park, Uganda (hereafter Kibale) where local communities' perception of the park became negative (MacKenzie et al. 2017). People's perspective is a function of historical management rules; wild animals damaging the crops (Bortolamiol et al. 2017; MacKenzie and Ahabyona 2012), a prohibition of local communities to enter the park and use its resources, and a concept of nature as a marketable good (i.e., tourism). This negative perception is made worse as the park's management of revenue sharing programs does not directly benefit the individuals suffering from wild animals' eating their crops, human injuries, and loss of property. Tourism, especially the one focusing on primates, is the second most important income earner of Uganda (MacKay and Campbell 2012; Republic of Uganda 2012; Uganda Vision 2040 2013). Kibale is a hotspot for primate tourism and was recently recognized the primate capital of Africa by safari circles[1], and the main

1 Chimp reports: https://chimpreports.com/discover-worlds-primate-capital-kibale-forest-national-park/, consulted June 24th, 2018

attraction is chimpanzee (*Pan troglodytes schweinfurthii*) vision tourism (Kagoro unpublished data). Tourism generates most of Kibale's revenue. Within local communities, chimpanzees are generally known to show "respect" towards people (by their discretion), while they are also "dangerous" (Hill and Webber 2010).

Sebitoli area, the northern section of Kibale (25 km^2, Figure 1) is embedded in an anthropogenic landscape (large tea, plantain, and eucalyptus plantations, small gardens, tarmac road). Here chimpanzee density is relatively high (Bortolamiol et al. 2016). To protect endangered chimpanzees (Appendix I CITES, Endangered on the IUCN red list) and their forest ecosystem, a Uganda Wildlife Authority (UWA) camp hosting rangers and eco-tourists is located near the village of Sebitoli. In the area, eco-tourism consists in bird watching and nature walks, but primate watching is not developed. However, scientific research on chimpanzee ecology has been carried out since 2008 (Sebitoli Chimpanzee Project – SCP).

Here we investigate if a positive relationship remains between local communities and the forest in Sebitoli area that could promote human-wildlife relationships, and help both human development and nature conservation. If so, we explore if its persistence expressed through four ways: 1) local communities' memory of wildlife related knowledge (plant and animal species); 2) cultural traditions, specifically clans and totems, and 3) spiritual beliefs about the forest that both link humans to wildlife; and 4) people's locations where inhabitants living near the park and far from modern infrastructures have a more diverse and vivid memory about wildlife.

We first provide historical background of the area since the arrival of British administrators to understand how local communities have been gradually distanced from wildlife and its management. Second, we carry qualitative, quantitative, and geographical analysis, including georeferenced inquiries and mapping, to analyze the above four points. Finally, we consider the importance of these links for conservation in this and other regions.

MATERIAL AND METHODS

Study area

Kibale's primate biomass is one of the highest in the world (Chapman and Lambert 2000; Chapman et al. 2018) and the park hosts a number of endangered species, including chimpanzees and elephants (*Loxodonta africana*). Outside Kibale there are up to 335 people/km^2 inhabiting a five kilometers buffer zone (Hartter 2010) dedicated to agriculture: local communities grow crops on small farms and some people work in large tea plantations, a large part of this labor force (40 to 60%) being from districts other than those neighbouring the park or even from outside Uganda (Mbale and Ogwal 2015). Within this zone, human density is growing faster than employment opportunities and local communities are disappointed that the number of people employed by the PA did not increase, as much as the number of researchers and tourists (MacKenzie et al. 2017).

Kibale culture and history of biodiversity management

Kibale is located in the Tooro kingdom and local communities are composed of two major ethnic groups: Batooro and Bakiga. Bakiga are fewer and arrived in the region later than Batooro, primarily in the 1950s, but they have similar social system and beliefs (Hartter et al. 2015). The roots of both groups are linked to the Cwezi dynasty (ancestral gods) who reigned over the Great Lake region and had mystical powers, such as control over rain, hunting, and human fertility (Chrétien 1985; Doyle 2007; Steinhart 1977). People in the region remember vivid narratives about these ancestral gods (Steinhart 2011). Also, clans (a collective of people who descend from the same distant ancestor; Beattie 1971; Roscoe 1968) have a central role in social and environmental interactions in the area. Each clan has one to several totems – an animal, a plant and/or an object – that clan members must respect and not kill or harm because of its links to a clan's ancestor (taboo).

When the Imperial British East African Company arrived in the area (1891), it supported Tooro against Bunyoro kingdom and British were granted powers over Batooro resources. It institutionalized biodiversity management and changed the established hierarchical system (Johnstone and Kasagama 1906; Kasagama and Lugard 1891; Naughton-Treves 1999; Toro agreement 1900). Hunting rules were defined (1906) distinguishing noble animals - elephants - that only an elite could hunt from vermin - lions, leopards, hyenas, bush pigs, vervets, baboons - that everyone could hunt (Graham 1973). In the mid-1920s, game reserves were established to control dangerous wild animals threatening humans, crops, and cattle (Brooks and Buss 1962; Morris 1978), but wildlife damages to crops were so problematic in the 1960s that elephants were killed *en masse*. Also, Kibale Forest Reserve was commercially logged at that time, especially the Sebitoli area where a saw-mill was operating (Struhsaker 1997).

In the 1970s, eight years of Idi Amin dictatorship and starvation seriously impacted wildlife (De Merode et al. 2007; Hamilton 1984). In Tooro, elephants, buffaloes, hippopotamus were decimated so Idi Amin forbid all types of hunting (GDA 1979 cited in Naughton-Treves 1999). In the 1970-80s, settlers moved into the south of Kibale and cleared approximately 70 km^2 of forest (MISR 1989; van Orsdol 1986). When the current president Yoweri Museveni came to power (1986), the Ugandan government again started to enforce regulation with respect to wildlife and biodiversity conservation. The population that moved into the south were expelled outside the Game Reserve and in 1993 the area became a national park.

When the area changed designation from a Forest and Game Reserve to a National Park (795 km^2), it was placed under the management of the UWA, itself under the Tourism, Wildlife and Antiquities Ministry. The Uganda Wildlife Act (Republic of Uganda 1996) regulates the uses and practices towards protected spaces and species, and grantees local communities' a limited access to exploit wildlife sustainably under the supervision of UWA rangers (not recruited locally and regularly transferred) in resource use zones. UWA shares 20% of revenues generated by park entrance fees with local communities (UWA 2000) and the money is distributed to benefit community projects (Hartter and Ryan 2010). The funds are channeled through the district local government, where they are taxed. Both resources' access and revenue sharing

programs successes are controversial and difficult to monitor, but UWA is seeking improvements (Adams and Infield 2003; MacKenzie 2012; Tumusiime and Vedeld 2012).

Semi directed interviews and participative observations with human communities

Georeferenced surveys were conducted in three villages: Kihingami, Nyakabingo, and Sebitoli, around Sebitoli area (January-April 2012, some information relative to clans and totems were confirmed in 2016) with the help of a local translator (Figure 1). This sample was designed to be in the close vicinity of the park and respondents were selected according to the distance between their home and the park's edge, their loss due to crop feeding (MacKenzie 2012), and proximity to landscape features (Table 1): Sebitoli village is the closest village to the park, the UWA station and the asphalt road and experiences medium losses due to crop feeding; Kihingami is located further from the park, the tarmac road, and UWA station than Sebitoli village and experiences high losses due to crop feeding; Nyakabingo is located closer to the park, but further to the road and UWA station than Kihingami and experiences medium losses due to crop feeding.

Our objectives were presented to village chiefs who directed us to volunteer informants. Participants were ensured of anonymity in an informed consent form and the research followed the guidelines of the Declaration of Helsinki and Tokyo for humans, and complied with a Memorandum of Understanding [MoU] for research and conservation in Kibale National Park between Museum national d'Histoire naturelle, Uganda Wildlife Authority and Makerere University (SJ445-12).

Georeferenced semi-directed interviews and participative observations were conducted simultaneously with 30 participants (10/village) at the respondents' home during their daily activities (Bortolamiol 2014). For brevity, we cite the information as followed: "N_i= 30" designates the population interviewed in the three villages; "$N_{spirits}$= 31"

Table 1. Spatial characteristics of the survey area

	Kihingami	Nyakabingo	Sebitoli
Distance from households' residence to the closest park edge (m)	142 - 770	11 - 183	45 - 938
Distance from village centroid to the closest road (m)	525	7000	0
Distance from village centroid to UWA station (m)	1340	4521	447
Distance from village centroid to the closest tea plantation (m)	10	320	195
Distance from village centroid to the closest tea factory (m)	2084	3816	560
Intensity of crop feeding loss (adapted from MacKenzie 2012)	High	Medium	Medium
UWA compensation (apart from revenue sharing; MacKenzie 2012)	Elephant trench and school	Elephant trench, school and bridge	Elephant trench and school
Approximate area (km^2)	0.65	0.25	0.3
Store number in the village	7	0	14

Legend: Characteristics of Kihingami, Nyakabingo, and Sebitoli villages around Kibale National Park, Uganda

the people interviewed in the three villages and a supplementary conversation about specific tree spirits. None of the 12 women and 18 men we interviewed were employed by the park and their main activity was agriculture. They were aged between 17 and 74 years old (mean 40 years old) and apart a mother and her daughter, none of them were related.

All villagers were asked about their tribe, clan, and totem, about plants they used in their daily activity, and wild animals they knew from the park. We used the excel FLAME 1.1 supplement (Pennec et al. 2012) to list the frequency and rank citation of animal species. We classified responses about animals in nine groups based on morphological/biological criteria (Table 2). Respondents used vernacular names to identify plant and animal species, which were later translated. When they did not know the species, they often cited the general taxa. As for questions related to beliefs about chimpanzees and spirits, respondents were asked two questions: *"Do you know stories about chimpanzees/spirits in the area?"* If respondents answer was "Yes" we would ask *"Can you tell us more about these stories?"* and if the answer was "No" we would move to another question. These two questions were open ended and led to a diversity of narratives that we compiled by themes. Finally, spirits locations - Ebiigasaigasa, Kaliisa, and Nyakakaikuru -, were mapped based on the village where respondents cited them, to verify the influence of geographical factors using GIS (Bortolamiol 2014; ArcGIS 10.2; Figure 1). The specific locations of some features (Rugamba, magical stones) were mapped thanks to respondents who brought interviewers to these specific locations.

We verified the relationships between wildlife related knowledge (plants, animals, spirits), social (tribe, totem) and geographical variables (households' residence distance to the park, villages' location; Add file 1). SPSS Statistics (IBM, version 24) was used to conduct parametric (Fisher exact test – several qualitative variables, Pearson correlation – two qualitative variables) and non-parametric tests (Mann-Whitney – a quantitative variable and two groups of qualitative variables, Kruskall-Wallis – quantitative variable and more than two groups of qualitative variables). The combination of such methods produced a qualitative analysis supported by a simple quantitative approach.

RESULTS

Wildlife related knowledge: plants as useful resources and animals as abundant neighbours

The people we interviewed use plant species for medicine (N_i=22 respondents, 48 species), firewood (N_i=22 respondents, 23 species), timber (N_i=5 respondents, 16 species), and other uses (N_i=10 respondents, 12 species; baskets, building, charcoal, fence, fertilizer, hygiene, planting trees, poultry, roof top). For medicine, *Vernonia amygdalina* (N_i=13), *Ocimum gratissimum* (N_i=8), and *Bidens pilosa* (N_i= 6) are mostly found in bushland, gardens, or forest edges. For firewood, respondents mostly used planted species, such as *Eucalyptus* sp. (N_i=14), *Bridelia micrantha* (N_i=6), and *Sesbania sesban* (N_i=5; Add file 2).

Ethno-zoological knowledge was gathered by asking which animals lived in Kibale. Respondents cited 45 answers: 29 referred to distinct species and 16 to general taxa – monkeys, red monkeys

(*Cercopithecus ascanius* or *Procolobus rufomitratus*), colobus monkeys (*P. rufomitratus* or *Colobus guereza*), antelopes, wild pigs, wild rabbits, rats, squirrels, birds, butterflies, snakes, frogs, insects, small insects, millipedes, ants. Among nine morphological groups, primates (N=15) and ungulates (N=11; Table 2) had the highest diversity of species. Among the animal citations, gorillas, de Brazza monkeys, patas monkeys, cranes, goats, and rhinoceros are not present in Kibale. Hippopotamus are found 40 km to the south of the Sebitoli area. The presence of lion or leopard in the area is extremely rare (lions do not reside in Kibale and leopard are very rare - Chapman unpublished data).

Elephant (93.1%, citation rank=1.6), chimpanzee (89.7%, citation rank=4.4), and baboon (86.2%, citation rank=2.3) were the most cited taxa (2/3 of the sample). The morphological group that was cited more often was primates (120/218 citations, 55%).

Human-wildlife relationships: a distended link with chimpanzees

All villagers stated that baboons and chimpanzees caused less damages than elephants. The most mentioned physical trait of chimpanzees was their resemblance to humans (N_i=17) and the fact that they have no tail (N_i=7) unlike other primates. Chimpanzees are reported to be more selective than elephants and baboons in the crops they feed, preferring maize and sugarcane (N_i=9). Villagers noted that some chimpanzees play a sentinel role, while others feed on crops (N_i=4; Add file 3) and often chimpanzees wait until humans are not in their field before entering it (N_i=5) or wait until the night (N_i=4; verified with infrared cameras - Krief et al. 2014). Chimpanzees are easy to scare away because they are fearful, but three women stated they were at risk of sexual abuse by chimpanzees and two stated there was a risk of chimpanzees kidnapping their baby.

A mother and her daughter had a narrative about chimpanzees in Kihingami and stated that a long time ago humans fled to the forest to avoid paying taxes and transformed into chimpanzees over generations because they lived in the forest (Add file 4).

Traditions linking humans to wildlife: wild and domestic totems

The people interviewed were primarily Batooro (70%; N_i=21) and Bakiga (20%; N_i= 6), but immigrants from Rwanda were also included (10%; N_i=3). Each village had a similar number of clans (9 or 10; 13 different clans in total; Table 3). Clans' membership influences social relationships and members of the same clan often help each other in times of financial needs "when someone is sick, they help, when someone dies they help, when someone needs to go to school they help". However, nowadays clans inter-marry while it is "not wise to mix-up because of inbreeding risks and general confusions with ancestral clans' rules".

Each respondent is a clan member and has a totem, with a duty to protect (N_i=21) and not to eat or hurt his or her totem (N_i= 20). Eight out of 13 totems were wild animals (Table 3), but some of these species are not now in Sebitoli (lion, leopard, and hippopotamus). Two-third of respondents have wild animals as totems (N_i=20), and one-third have domestic animals, crops, or object as totems (N_i=10).

Beliefs linking humans to wildlife

Out of 31 people asked about spiritual

Table 2. General knowledge about wild animals

Species and general taxa	Occurrence (N_i= 30)	Frequency (%)	Rank citation	Presence in Kibale National Park according to scientists
Large mammals				
Elephant (*Loxodonta africana*)	27	93.1	1.6	Yes
Lion (*Panthera leo*)	3	10.3	7	No (occasional visits from neighbouring Queen Elizabeth National Park)
Primates				
Chimpanzee (*Pan troglodytes schweinfurthii*)	26	89.7	4.4	Yes
Baboon (*Papio anubis*)	25	86.2	2.3	
Monkey (general)	21	72.4	4.2	
Black and white colobus (*Colobus guereza*)	17	58.6	6.5	
Red tailed monkey *(Cercopithecus ascanius schmidti)*	11	37.9	6.9	
Red colobus (*Procolobus rufomitratus)*	6	20.7	7.2	
Vervet (*Chlorocebus pygerythrus*)	3	10.3	5	
Gorilla (*Gorilla* sp.)	2	6.9	3.5	No
L' Hoest monkey (*Cercopithecus lhoesti*)	2	6.9	12	Yes
Mangabey (*Cercocebus albigena*)	2	6.9	10.5	
Patas monkey (*Erythrocebus patas*)	1	3.5	13	No
De Brazza monkey (*Cercopithecus neglectus*)	1	3.5	17	
Blue monkey (*Cercopithecus mitis*)	1	3.5	19	Yes
Red monkey (general)	1	3.5	4	
Colobus (general)	1	3.5	4	
Birds				
Bird (general)	6	20.7	8.3	Yes
Owl (*Strigiformes* sp.)	1	3.5	6	
Crane (*Balearica regulorum*)	1	3.5	9	No (typically outside but can be found to the south of the park)
Guinea fowl (*Numida meleagris, Guttera pucherani*)	1	3.5	3	Yes
Reptiles				
Snake (general)	4	13.8	5.3	Yes
Ungulates				
Wild pig (general)	9	31	6.3	Yes
Bushbuck (*Tragelaphus scriptus*)	5	17.2	7	
Buffalo (*Syncerus caffer*)	5	17.2	7.4	
Blue duiker (*Cephalophus monticola*)	4	13.8	8	
Antelopes (general)	2	6.9	6	
Giant forest hog (*Hylochoerus meinertzhageni*)	2	6.9	7.5	
Warthog (*Phacochoerus aethiopicus*)	2	6.9	6	
Red duiker (*Cephalophus harveyi*)	2	6.9	6.5	
Rhinoceros (*Diceros biscornis*)	1	3.5	5	No
Hippopotamus (*Hippopotamus amphibius*)	1	3.5	9	Yes (rare, not in respondents' daily environment)
Goat (*Capra* sp.)	1	3.5	13	No
Small ground mammals				
Rat (general)	8	27.6	5.4	Yes
Squirrel (general)	2	6.9	17	
Mongoose (*Herpestidae* sp.)	2	6.9	6	
Wild rabbit (general)	1	3.5	5	
Mouse (general)	1	3.5	13	
Hedgehog (*Atelerix* sp.)	1	3.5	12	
Insects				
Insect (general)	1	3.5	6	Yes
Butterfly (general)	1	3.5	6	
Millipedes (general)	1	3.5	6	
Small insect (general)	1	3.5	5	
Ant (general)	1	3.5	4	
Amphibian				
Frog (general)	1	3.5	7	Yes

Legend: Wild animal species cited by villagers from Kihingami, Nyakabingo and Sebitoli (N_i= 30) to be within Kibale National Park, Uganda. The information was classified by morphological/biological traits (NB: general taxa are underlined)

Table 3. Respondents' tribes, clans and totems

Clan vernacular name	Totem vernacular name	Totem translation name	Kihingami villagers	Nyakabingo villagers	Sebitoli villagers	Batooro	Bakiga	Other tribes
Domestic animals (N= 8/30)								
Abakurungo	Etimba	Cow	0	2	1	2	1	0
Abasaigi	Nkira	Cow	1	1	0	2	0	0
Abasita	Busito	Cow	1	0	2	3	0	0
Wild animals (N= 20/30)								
Abagaya	Akateman-konge	Bird	0	1	0	0	0	1
Abagaya	Entale	Lion	1	0	0	1	0	0
Abazigaba	Ngabi	Bushbuck	0	2	0	0	2	0
Abazigaba	Ngo	Leopard	0	1	1	1	1	0
Abaziraija	Ngabi	Bushbuck	1	0	0	1	0	0
Abagweri	Ngabi	Bushbuck	1	0	1	2	0	0
NA*	Ngabi	Bushbuck	0	1	0	1	0	0
Ababopi	Ekigangoro	Centipede	0	0	1	1	0	0
Abaranzi	Ndaha	Guinea fowl	0	0	1	1	0	0
Abagahe	Ensere	Hippopotamus	1	1	0	1	0	1
Abahinda	Enkende	Monkey	3	1	2	5	1	0
Crops and objects (N= 2/30)								
Abanyonza	Ekyayaya	Banana	1	0	0	1	0	0
Abasambo	Empindo	Needle to make baskets	0	0	1	0	0	1

Legend: Tribes, clans, and totems of respondents (N_i= 30) in Kihingami, Nyakabingo and Sebitoli villages (* missing data) around Kibale National Park, Uganda

knowledge, 20 shared information; these people described two types of spirits: fixed and transient (Figure 1). All transient spirits navigate at the forest edge, some go within the forest and some stay outside, while fixed spirits are located along an anthropogenic element, the tarmac road. All spirits are met in particular areas linked to villagers' daily life (i.e., stones, trees, valleys, wetlands, forest edges), mostly at night, and can be associated to alcohol consumption (Add file 5).

Rugamba and Engote trees: fixed spirits symbolizing nature's resistance to human activities

The Rugamba tree (a *Ficus saussaureana* tree) was mentioned in eight interviews; one person living in Sebitoli village was identified by four of the people that we interviewed as being particularly knowledgeable about the tree because he/she used to visit the tree (Add file 6a). Rugamba is not a vernacular name for a tree species, but refers to a specific individual tree. The main respondent led us to the "remaining babies of the tree", located in the park, 20 m from the tarmac road ($N_{spirits}$=6) and/or by rivers ($N_{spirits}$=3). The original tree was cut ($N_{spirits}$=3) when the road was built by "Italian white men" ($N_{spirits}$=4), leaving sprouting stems ($N_{spirits}$=2; "There is a small one, inherited from the other one", "After three days, (….), a young one came out and was produced from that main big one. Up to now it is still there"). However, the sucker does not have the same powers as the original tree that was possessed by a spirit, could talk, and people would come to sacrifice to that tree ($N_{spirits}$=5). Three villagers said that the tree was talking while being cut but each informer had a different version of this speech (Add file 6a).

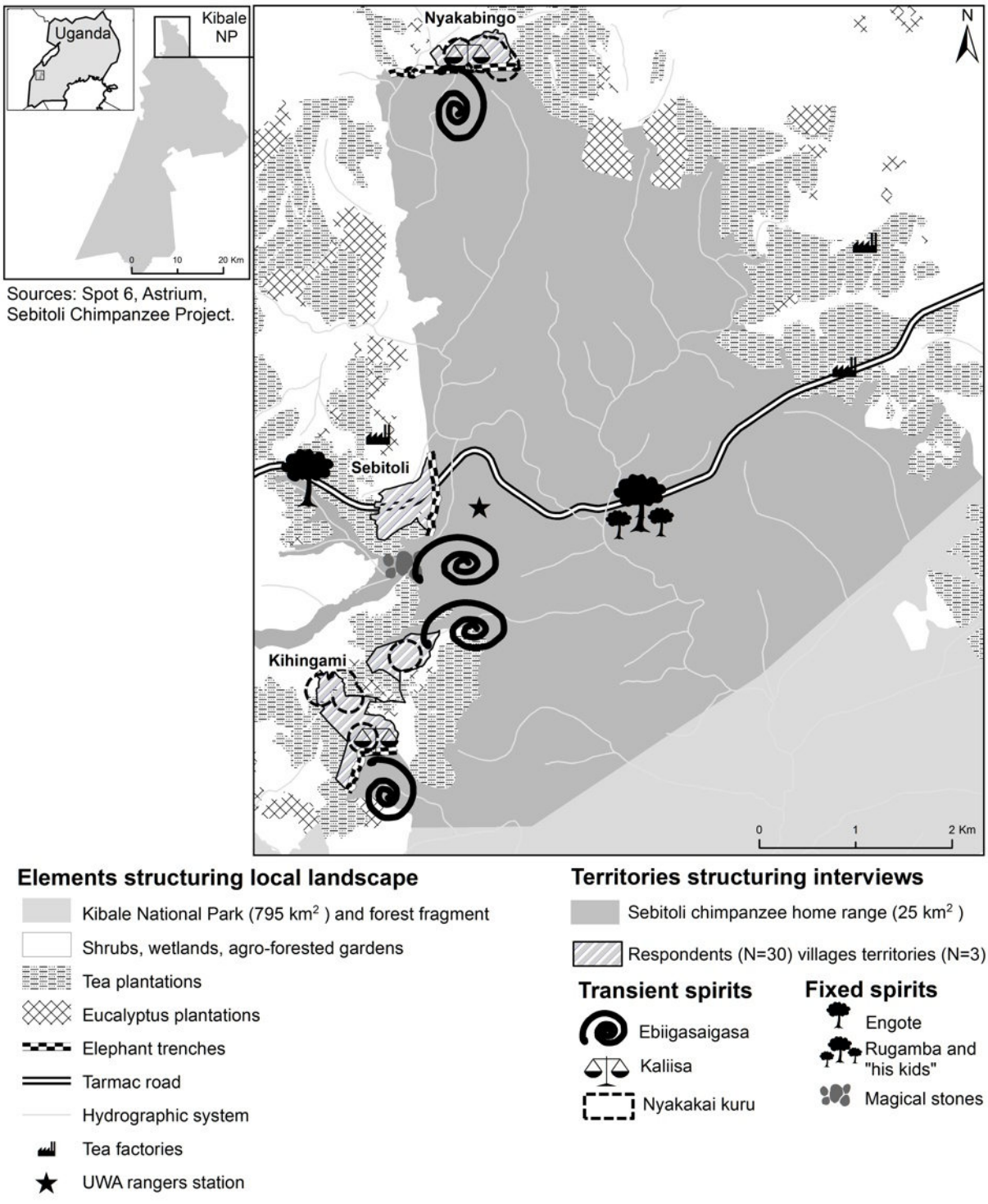

Figure 1. Locations of fixed and transient spirits within/around Sebitoli area (Kibale National Park, Uganda) according to respondents ($N_{spirits}$=31) from Kihingami, Nyakabingo and Sebitoli villages.

The Engote tree (vernacular name for *Prunus africana*) was mentioned in two interviews (the same person identified in Sebitoli about Rugamba, and one person in Kihingami - Add file 6b, c). The story of Engote tree was less detailed, but resembles the one of Rugamba as the tree resisted to be cut by humans. However, its resistance continued after its death as respondents stated that the spirit inhabiting the tree revenged itself from being cut by killing eight people in a bus accident where the tree was originally located.

Transient spirits

Kaliisa, a forest hunter spirit (N_i=3), was cited in 11 interviews. It is described to move with barking dogs (N_i=3), crying (N_i=1), difficult to observe (N_i=1), and resembling a tall human (N_i=2) or an animal (N_i=1). The association between Kaliisa and sacrifice (offering animal parts to the spirit) was made in two interviews, but Kaliisa has been described more frequently as guarding and grazing cattle in pasture (N_i=5). If hunters ask Kaliisa's permission to hunt in the forest, the spirit will watch the hunter's safety, as well as his cattle. Kaliisa is bridging the gap between the agricultural and forested worlds, watching cattle, humans and wild animals (Figure 1).

Ebiigasaigasa, the "carrier", was mentioned in 11 interviews. This spirit is of great height (N_i=5), and shows a similarity with humans in general (N_i=2) or “white people” in particular (N_i=3). When it is moving, it is surrounded by light (N_i=4). Ebiigasaigasa "kidnaps" a person it meets at the forest edge (Figure 1; N_i=11) and transports he/her "somewhere else" (N_i=4) or inside the forest (N_i=3). This spirit is associated with night encounters (N_i=8) and particular places (stones N_i=6; mountain/hills N_i=2; wetland/valleys N_i=1; water hole N_i=1). Three people mentioned that the risk of encountering Ebiigasaigasa increased with alcohol consumption and with the proximity to magical stones (Figure 1).

Nyakakaikuru, a "greedy" spirit mentioned in nine interviews, is encountered at night (N_i=4). A third of the respondents mentioned that Nyakakaikuru is harmless as it only passes through land (N_i=3). It comes at night and visits villagers’ kitchens to find food. According to all interviews, each household leaves a dish full of food in the kitchen at night. If Nyakakaikuru comes and finds no food, it can destroy materials in the house.

During interviews, respondents (N_i=4) stated that fixed and transient spirits were evils that no one still believe in. When respondents were asked why people no longer believed in them, they stated that belief in them disappeared when Christianity developed (N_i=4) and with modernization (N_i=3).

Geographical and social variations of wildlife related knowledge and spiritual beliefs

Statistically significant relationships between wildlife related knowledge, social and geographical factors are few (Add file 1). Batooro are over-represented in Kihingami, and under-represented in Nyakabingo (p= 0.004) and they live further from the forest edge than Bakiga (p= 0.044; mean=327.3 m vs. 81.5 m). A higher diversity of firewood species are cited in Nyakabingo (p=0.036; mean Sebitoli=1.3; Kihingami=2.8; Nyakabingo=3.3). Also, the number of timber species is higher for other tribes (p=0.033; mean=4.3), than Batooro (mean=1) and Bakiga (mean=0.24). Villagers’ residency influenced spiritual beliefs (p=0.028) as most citations were obtained in Nyakabingo and

Kihingami (N_i=33), and the least in Sebitoli village (N_i=5). Rugamba fixed spirit was mostly cited in Sebitoli village (5 out of 8; Figure 1). Kaliisa and Nyakakaikuru (respective p=0.0006, 0.037) were mostly cited at Nyakabingo.

DISCUSSION

Although the local populations were largely excluded from biodiversity management around Kibale, wildlife related knowledge remains in the Sebitoli area through animals and plants' knowledge, culture (totems), spiritual beliefs (fixed, transients), but knowledge varies among villages. Wildlife related knowledge was not generally related to social and geographical factors. This could be due either to our sample size, a weakened link between humans and wildlife, and/or a relatively small quantity of wildlife related knowledge shared equally and independently from social or geographical characteristics. In Nyakabingo, the village with fewer facilities and shops and further from the tarmac road, there are more Bakiga (who live closer to the park in general), spirits' citations (especially transients), and species used for firewood. No social and geographical links are established with animal related knowledge, but wild animal remain the major totems of local populations.

Wildlife related traditions and knowledge

Villagers' identities include wild animal totems, which they have a duty to protect independently from their tribes' membership. Thus, totems may still play a significant role in biodiversity conservation, as evoked in our literature review. Villagers are aware of a diversity of wild animal species and besides approximations (general taxa, species that do not live in Kibale), the most frequently cited species (e.g., elephants, chimpanzees, baboons) are also the most frequent species coming out of the forest and feeding in gardens (MacKenzie 2012, MacKenzie and Ahabyona 2012). Other animal species occur in fields and houses (e.g., rats, squirrels, frogs, mongooses, goats, insects) or are hunted (ungulates, elephants, and small terrestrial mammals), an activity which is illegal. Also, wild plant species are still used by local communities in their daily activities (medicine, firewood, timber), but are likely found at the park's edges, in bushlands, or are being planted.

Legends and traditions related to animals are rare (or rarely mentioned), but chimpanzees are resembling humans, no matter respondents' tribe or location. We suggest that the narrative of local communities depicting a close affiliation between humans and chimpanzees implies four things: (1) chimpanzees are "descendants" of humans; (2) the way of life distinguishes humans from the great apes; (3) the fragility of the human condition, and their economic vulnerability; and (4) the forest seems to play a filtering role and reveals the discontinuity between the two species. This narrative is similar to others that refers to the bonobos in the Democratic Republic of Congo (Narat et al. 2015) and the chimpanzees in Republic of Congo (Köhler 2005), Nigeria (Nyanganji et al. 2010), and Guinea Bissau where local people said that chimpanzees were the species they would like to be if they were not human and they noticed a close resemblance between species in terms of morphology (face, feet) and behavior (gestures, bipedalism; Costa et al. 2013; Sousa et al. 2014).

Unlike the stories about wolf-children

(Aroles 2007) and the fictional character of Mowglie (Kipling 1895), chimpanzees descending from humans never returned to their original environment, which has interesting conservation dimensions: the forest is today the territory of chimpanzees and not the "natural" territory of men, but their refuge in case of threat. Each species belongs to a specific area: the park is currently inhabited by chimpanzees and villages are inhabited by humans. Looking alike human, the chimpanzee is not usually consumed for its meat in Uganda (Peterson and Goodall 1993). However, one chimpanzee was recently hunted and killed near Sebitoli village (Krief unpublished data) which may reflect a detachment of traditions, or may have resulted because many workers come from other areas of Uganda or from neighbouring countries with different food taboos.

A link with wildlife through spiritual beliefs

Wild animals remain in villagers' knowledge about nature (totems, species diversity), but they are absent in spiritual beliefs which are mainly trees, minerals or human shaped. The power of nature (trespassing boundaries; seismic activities; thunder, rain, fire, etc., - Chapman et al. 1999; Krief and Brunois-Pasina 2017) is illustrated by transient spirits, but their representations are influenced by geographical features. For example, people living in villages beside the tarmac road have a less persistent perception of an intangible link with natural elements. Also, close proximity to facilities and the tarmac road facilitates contacts with tea workers and foreigners, and may promote loss of these links to nature.

Orally transmitted stories about spirits still exist and link humans with the wildlife of the park. Spirits symbolize the relationship between wild and human territories that are currently perceived by villagers as asymmetrical, since they are forbidden to enter Kibale without UWA permission (but they trespass it; Bortolamiol unpublished data), while spirits and wild animals have the "permission" to cross or make humans cross the forest edge for certain activities (e.g., crop feeding). This perceived asymmetry can lead people to feel left aside of conservation management (MacKenzie 2012) and may promote actions the park views as negative (e.g., poaching - Bortolamiol unpublished data).

Narratives we collected about wildlife and spirits testify a complex relationship to foreign elements, such as fear of taxes and fear of "white man". When Christian missionaries arrived in Uganda, some cults were driven underground (Behrend 2011) but their positive and rehabilitating aspects could be used in conservation awareness programs (Rubongoya 2003). In Sebitoli area, modernization and development may participate in blurring traditional and wildlife knowledge as it was showed in Bolivia where plant use changes were more acute in villages close to market towns than in remote villages over time (Reyes-Garcia et al. 2013). This is why the weak influence of geographical distance (to infrastructures: roads, tea factories; fixed spirit etc.) is an indirect factor, suggesting the importance of acculturation.

Changing scale: promoting regional conservation efforts through local ecological knowledge

Positive aspects of totemic and spiritual beliefs are not currently integrated in biodiversity conservation programs within

local communities around Kibale, because there was no clear evidence about them. However, as the world faces new animal extinction (Ceballos et al. 2017) besides the international conservation programs that were set the last 30 years, scientists "urge the conservation community to move beyond superficial engagement with the conservation of social sciences" (Bennett et al. 2017). They also urge for a better application of international guidelines (integration of local communities' knowledge) into local management plans. Indeed, informal institutions (Rim-Rukeh et al. 2013), such as totemic and spiritual systems, can drive human behaviors and self-connectedness to nature (Schultz 2011; Tam et al. 2013; Zelenski and Nisbet 2014). Then, they can influence positively human-wildlife relationships and people's will to participate in nature conservation. Learning from and using local communities' traditional knowledge (such as why/which species and places are protected in the traditions) may not only be a tool to help build the much-needed consensus between conservationists and local people, but it can also give communities a sense of ownership of wildlife management projects (Berkes 2004).

Historical, social, and geographical factors contribute to the connection of local communities with nature and should be considered alongside species, places, and ecological knowledge when formulating conservation and management plans. However, care should be given to revive specific narratives and practices that encourage biodiversity friendly behaviors rather than destroy it (Etiendem et al. 2011; Holmes et al. 2017; Masius and Sprenger 2015). In Kibale, further surveys should inquire if local communities wish to implement their traditional knowledge in conservation, what knowledge they want to promote, and how they want to promote it (school education, agricultural program, etc.). Researchers, NGOs, biodiversity managers and local communities could jointly develop an innovative biodiversity conservation management strategy to conserve wildlife and human related knowledge.

CONCLUSION

We investigated wildlife, traditional, and spiritual related knowledge among villagers living adjacent to Kibale National Park, Uganda and identified links between local communities and natural elements which are not currently emphasized in biodiversity management. Helping to maintain, revive, and integrate orally transmitted narratives in biodiversity management may increase conservation effectiveness in a more co-owned perspective. As Kibale became a center of primate vision tourism, a real exchange between biodiversity managers, tourists, and local communities could value and promote the links between humans and wildlife.

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Additional information 1: Social, spiritual and spatial variables statistical relationships (KW= Kruskal-Wallis, MWU= Mann-Whitney), Sebitoli area, Kibale National Park, Uganda.

	Household distance to forest edge (meters)	Village residency (3 categories)	Tribe (3 categories)	Clan (13 categories)	Totem (13 categories)
Tribe (3 categories)	(KW) H2= 6.258, **p. value= 0.044**	(Fisher) **p. value= 0.004**	-	-	(Fisher) p. value= 0.169
Clan (13 categories)	(KW) H2= 17.738, p. value= 0.168	(Fisher) p. value= 0.626	(Fisher) **p. value= 0.043**	-	-
Totem (13 categories)	(KW) H2= 15.349, p. value= 0.223	(Fisher) p. value= 0.838	(Fisher) p. value= 0.169	(Fisher) **p. value < 0.0001**	-
Sum of wild animal citation	(Correlation - Pearson) R= -0.082, p. value= 0.666	(KW) H2= 3.338, p. value= 0.188	(KW) H2= 2.357, p. value= 0.308	(KW) H2= 16.783, p. value= 0.209	(KW) H2= 13.269, p. value= 0.350
Wild animal as totem citation (Yes/No)	(MWU) U= 87.5, p. value= 0.588	(Fisher) p. value= 1	(Fisher) p. value= 0.825	(Fisher) **p. value < 0.0001**	-
Humans resemble chimpanzees citation (Yes/No)	(MWU) U= 122, p. value= 0.650	(Fisher) p. value= 0.721	(Fisher) p. value= 0.852	(Fisher) p. value= 0.385	(Fisher) p. value= 0.524
Sum of medicinal plant species citation	(Correlation – Pearson) R= 0.002, p. value= 0.993	(KW) H2= 2.837, p. value= 0.242	(KW) H2= 1.691, p. value= 0.429	(KW) H2= 12.387, p. value= 0.496	(KW) H2= 11.444, p. value= 0.491
Sum of firewood plant species citation	(Correlation – Pearson) R= -0.287, p. value= 0.124	(KW) H2= 6.649, **p. value= 0.036**	(KW) H2= 0.202, p. value= 0.904	(KW) H2= 8.166, p. value= 0.833	(KW) H2= 7.953, p. value= 0.789
Sum of timber plant species citation	(Correlation – Pearson) R= -0.236, p. value= 0.209	(KW) H2= 2.329, p. value= 0.312	(KW) H2= 6.796, **p. value= 0.033**	(KW) H2= 12.235, p. value= 0.508	(KW) H2= 13.729, p. value= 0.318
Sum of other plant species citation	(Correlation – Pearson) R= -0.131, p. value= 0.490	(KW) H2= 4.478, p. value= 0.107	(KW) H2= 3.059, p. value= 0.217	(KW) H2= 17.576, p. value= 0.174	(KW) H2= 17.599, p. value= 0.128
Kaliisa citation (Yes/No)	(MWU) U= 78, p. value= 0.268	(Fisher) **p. value= 0.0006**	(Fisher) p. value= 0.095	(Fisher) p. value= 0.210	(Fisher) p. value= 0.398
Nyakakaikuru citation (Yes/No)	(MWU) U= 87.5, p. value= 0.756	(Fisher) **p. value= 0.037**	(Fisher) p. value= 0.561	(Fisher) p. value= 0.718	(Fisher) p. value= 0.778
Ebiigasaigasa citation (Yes/No)	(MWU) U= 114.5, p. value= 0.672	(Fisher) p. value= 0.089	(Fisher) p. value= 0.289	(Fisher) p. value= 0.382	(Fisher) p. value= 0.624
Rugamba citation (Yes/No)	(MWU) U= 98, p. value= 0.413	(Fisher) p. value= 0.429	(Fisher) p. value= 0.089	(Fisher) p. value= 0.491	(Fisher) p. value= 0.434
Sum of transient spirit citation	(Correlation - Pearson) R= -0.131, p. value= 0.490	(KW) H2= 11.340, **p. value= 0.003**	(KW) H2= 5.238, p. value= 0.073	(KW) H2= 15.124, p. value= 0.300	(KW) H2= 11.833, p. value= 0.459
Sum of fix spirit citation	(Correlation - Pearson) R= 0.127, p. value= 0.505	(KW) H2= 2.522, p. value= 0.283	(KW) H2= 4.812, p. value= 0.090	(KW) H2= 12.789, p. value= 0.464	(KW) H2= 13.689, p. value= 0.321
Sum of overall spirit citation	(Correlation - Pearson) R= -0.089, p. value= 0.639	(KW) H2= 7.137, **p. value= 0.028**	(KW) H2= 3.771, p. value= 0.152	(KW) H2= 15.142, p. value= 0.299	(KW) H2= 10.864, p. value= 0.541

Additional information 2a: Medicinal plant species used by respondents (N_i=30), Sebitoli area, Kibale National Park, Uganda.

Medicinal plant species	Vernacular Common Name	Citation in Kihingami	Citation in Nyakabingo	Citation in Sebitoli	Total
Acanthus pubescens	Amatojo	1	0	1	**2**
Aframomum angustifolium	Amatehe	0	0	1	**1**
Albizia coriaria	Omusisa	0	1	0	**1**
Aloe vera	Enkokorutanga	3	1	0	**4**
Artocarpus heterophyllus	Jack fruit	1	1	0	**2**
Bidens pilosa	Nyabarasana	2	4	0	**6**
Blighia unijugata	Omwataibale	0	1	0	**1**
Brachiaria decumbens	Ejubwa	0	0	1	**1**
Camellia sinensis	Amajani	1	0	0	**1**
Carica papaya	Pawpaw	0	1	0	**1**
Cassia didymobotrya	Omuchora	1	0	0	**1**
Catha edulis	Amairungi	0	0	1	**1**
Conyza floribunda	Ekinyansambu	0	0	1	**1**
Crassocephalum montuosum	Ekiinami	0	1	0	**1**
Cymbopogon citratus	Kalifuha	0	1	0	**1**
Cyphomandra betacea	Ekidodoima	0	1	1	**2**
Dichrocephala integrifolia	Omubuza	0	1	0	**1**
***Dioscorea* sp.**	Ebinyongo	0	1	0	**1**
Diospyros abyssinica	Omuhoko	0	1	0	**1**
Dracaena fragrans	Omugorogoro	2	0	0	**2**
Erlangea cordifolia	Entooma	0	1	0	**1**
Erlangea tomentosa	Ekitokotoko	0	1	2	**3**
Guizotia scabra	Ekiterankuba	1	0	0	**1**
Hoslundia opposita	Orutotoimya	1	0	1	**2**
Ipomoea batatas	Enkoora	0	1	0	**1**
Kalanchoe pinnata	Enyondo	1	1	0	**2**
Lantana trifolia	Omusekera	0	1	1	**2**
***Macaranga* sp.**	Omukoko	1	0	1	**2**
Maesa lanceolata	Omuhangabagenzi	0	0	1	**1**
Mangifera indica	Omuyembe	0	1	0	**1**
Markhamia lutea	Omusambya	0	1	0	**1**
Momordica foetida	Omwihura	0	0	2	**2**
Mondia whitei	Omurondwa	0	0	1	**1**
***Musa* sp.**	Bitooke	0	1	0	**1**
Ocimum gratissimum	Ekijaaja	5	2	1	**8**
Ocimum rothii	Omweya	2	1	2	**5**
Persea americana	Avocado	0	1	0	**1**
Plectranthus barbatus	Ekinyamunsunga	1	0	0	**1**
Prunus africana	Engote	2	1	1	**4**
Psidium guajava	Amapera	1	2	1	**4**
Ricinus communis	Ebisogasoga	0	3	0	**3**
Sonchus oleraceus	Ekizimyamurro	0	1	0	**1**
Spathodea nilotica	Omunyarra	0	0	1	**1**
Tagetes minuta	Omukazimurofu	0	1	1	**2**
Turraea africana	Embahira	0	2	0	**2**
Vanilla planifolia	Vanilla	0	1	0	**1**
Vernonia amygdalina	Ekibirizi	5	5	3	**13**
Zanthoxylum gilletii	Mutatembwa	0	0	1	**1**
Species number		**17**	**31**	**21**	**48**
Total citation		**31**	**43**	**26**	**100**

Additional information 2b: Firewood plant species used by respondents (N_i=30), Sebitoli area, Kibale National Park, Uganda.

Firewood plant species	Vernacular Common Name	Citation in Kihingami	Citation in Nyakabingo	Citation in Sebitoli	Total
Acanthus pubescens	Amatojo	1	0	1	**2**
Albizia grandibracteata	Omurungo	0	4	0	**4**
***Allophylus* sp.**	Kabiriti	1	0	0	**1**
Blighia unijugata	Omwataibale	1	1	0	**2**
Bridelia micrantha	Omubaragaza	1	4	1	**6**
***Eucalyptus* sp.**	Kalitesi	4	5	5	**14**
Fagara macrophylla	Omubakampungu	0	1	0	**1**
Ficus natalensis	Omutoma	0	2	0	**2**
Hoslundia opposita	Orutotoimya	0	1	0	**1**
***Macaranga* sp.**	Omukoko	1	0	2	**3**
Markhamia lutea	Omusambya	0	2	1	**3**
***Mytrogina* sp.**	Omuniamaizi	1	0	1	**2**
Newtonia butchananii	Omuchenche	1	0	0	**1**
***Olea* sp.**	Omusoko	0	1	0	**1**
Parinari excelsa	Amabura	1	0	0	**1**
Pennisetum purpureum	Omabingo	1	0	0	**1**
Polyscias fulva	Omujugantara	1	1	0	**2**
Prunus africana	Engote	3	0	1	**4**
Psidium guajava	Amapera	2	1	1	**4**
Ricinus communis	Ebisogasoga	1	3	0	**4**
Sapium sapindas	Omusasa	1	1	0	**2**
Sesbania sesban	Emibimba	2	2	1	**5**
Vernonia amygdalina	Ekibirizi	2	0	0	**2**
Species number		**17**	**14**	**9**	**23**
Total citation		**25**	**29**	**14**	**68**

Additional information 2c: Other plant species used by respondents (N_i=30), Sebitoli area, Kibale National Park, Uganda.

		Use									Location			
Other plant species	**Vernacular Common Name**	**Timber**	**Rooftop**	**Basket**	**Agriculture use**	**Plantation**	**Charcoal**	**Fence**	**Poultry**	**Hygiene**	**Citation in Sebitoli**	**Citation in Kihingami**	**Citation in Nyakabingo**	**Total**
Albizia coriaria	Omusisa	1	0	0	0	1	0	0	0	0	1	0	1	**2**
Albizia grandibracteata	Omurungo	0	0	0	1	0	0	0	0	0	0	0	1	**1**
Bridelia micrantha	Omubaragaza	1	0	0	0	1	1	0	0	0	0	1	2	**3**
Cassia didymobotrya	Omuchora	1	0	0	0	0	0	0	0	0	0	0	1	**1**
Celtis africana	Omujunju	1	0	0	0	0	0	0	0	0	0	0	1	**1**
Cordia millenii	Omutumba	2	0	0	0	0	0	0	0	0	0	2	0	**2**
***Eucalyptus* sp.**	Kalitesi	2	0	0	0	0	0	0	0	0	0	1	1	**2**
Fagaropsis angolensis	Omumara	1	0	0	0	0	0	0	0	0	0	0	1	**1**
Imperata cylindrica	Emisojo	0	2	0	0	0	0	0	0	0	1	1	0	**2**
Kalanchoe pinnata	Enyondo	0	0	0	0	0	0	0	0	1	0	1	0	**1**
***Macaranga* sp.**	Omukoko	1	0	0	0	0	0	0	1	0	0	1	1	**2**
***Mahogany* sp.**	Mahogane	0	0	0	0	1	0	0	0	0	0	0	1	**1**
Milletia dura	Emihakwa	1	0	0	0	0	0	0	0	0	0	1	0	**1**
***Mimusops* sp.**	Enkoba	3	0	0	0	0	0	0	0	0	0	0	3	**3**
Newtonia butchananii	Omuchenche	2	0	0	0	0	0	0	0	0	0	0	2	**2**
***Olea* sp.**	Omusoko	3	0	0	0	0	0	0	0	0	0	0	3	**3**
Pennisetum purpureum	Omabingo	1	0	0	0	0	0	0	0	0	0	1	0	**1**
***Phoenix* sp.**	Omuchindo	0	0	1	0	0	0	0	0	0	0	0	1	**1**
Prunus africana	Engote	2	0	1	0	0	0	0	0	0	1	2	0	**3**
Psidium guajava	Amapera	1	0	0	0	0	0	0	0	0	0	0	1	**1**
Ricinus communis	Ebisogasoga	0	0	0	1	0	0	0	0	0	0	0	1	**1**
Spathodea nilotica	Omunyarra	0	1	0	0	0	0	0	0	0	0	1	0	**1**
Vanilla planifolia	Vanilla	0	0	0	0	0	0	1	0	0	0	0	1	**1**
Zanthoxylum gilletii	Mutatembwa	2	0	0	0	0	0	0	0	0	0	0	2	**2**
Species number		**16**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**3**	**10**	**17**	**24**
Total citations		**25**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**3**	**12**	**24**	**39**

Additional information 3: Description of chimpanzee behavior while crop feeding, Sebitoli area, Kibale National Park, Uganda.

A villager described how two chimpanzees entered the field by one access point and as the owner of the field was trying to scare them away, two other chimpanzees entered by the opposite side of the field to obtain maize (entrance points were 90 m apart) and suggested this was an intentional strategy. This villager described having to go back and forth several times between the different points of the field to scare both groups away.

Additional information 4: Narrative told by a mother and her daughter evoking a distant subsidiary relationship between humans and chimpanzees, Sebitoli area, Kibale National Park, Uganda.

Long time, there used to be a family, the man and his wife. During that time, they had to pay taxes but they wanted to avoid paying them since they didn't have the money and the conditions were difficult. So they decided to go inside the forest. After reaching the forest, they stayed there for a long time and they gave birth. The kids they gave birth had hairs all over the body because of staying in the forest a lot, the food they found there and the conditions of the forest. They had kids and those kids also had kids. They happened to stay in the forest for their entire life. They accumulated, they became many and the population was extremely high. They ended up being called chimpanzees and that is how they came to exist.

Additional information 5: Aside respondents' answers about spirits and local beliefs around Sebitoli area, Kibale National Park, Uganda.

Other spirits discussed in interviews		Other believes-related information	
Stones	By the forest fragment, there are magic stones.	**Night**	I don't move at night so I don't know anything about the spirits.
	There are spirits at the stones. You can see footprints: cows feet and drum prints on the top of the stones, a chair also. There are bad spirits, at around 3pm, if you are there and you are a lady, they can rape you. They sing traditional songs and smoke cigarets. They can take you somewhere and you wake up sleeping in a bush.		Sometime, people who travel late at night, they get transferred another place they don't know. It take them deep inside the forest in the tree hole.
	There are ghosts at the stones. You loose your way, you disappear. They bit. Someone got lost from the forest because of the stones.		Scared to go by the forest at night.
	There was a stone from which Muhumuzo King used to address its people. A foreign company wanted to pass the road through the stone and they failed totally. They used dynamite but the next morning it was there again.		
	At the stones between Sebitoli and Kihingami: there are spirits that cries like babies at night. You ear those spirits when you are burning charcoal.		
Trees	Omukunga tree: people used to sacrifice and people used to take its bark. It was burnt for charcoal. It is no longer there. People used to come at night, not during the day.	**Spirits and official religions**	Bisaka: he is a man that has a religion. He saw Nakakay kuru once. Bisaka has many followers and assets. They don't use pet names, they don't use herbal medicine, if you want to grow crops Bisaka has to bless it, you can marry as many wives as you want. Nyakakaikuru the Bisaka stick in 2008 because Bisaa failed to sacrifice the way Nyakakaikuru wanted. Even the president Museveni goes to Bisaka.
	There is a tree with a big hole inside and some spirits inside. It is no more here now, it felt by itself.		White people like spirits. There was one called Dik, he liked this kind of things. He was sacrificing money, chicken.
	There are trees that talks in the forest.		No rituals, no spirits, no witches in Sebitoli (LC1).
	I don't really know but there are particular trees in the forest. For example Omurunga is a tree bringing confusion.		Spirits were there a long time ago before modernization.
			Since I am a believer, I don't know spirits.
Others: ghosts, cannibalism, night club spirits	Ghosts are in Sebitoli, they come from the forest to the community. They take people in the forest and you wake up not knowing what happened.		
	There are spirits in the forest, I can ear them 2 times a month. They come from down the valleys.		
	Emisamboua: it pass by people in the form of a woman. It gives you order so you do whatever it wants. It disorganizes you. It takes you where it wants in the forest.		
	Spirits are also in night clubs and take the form of beautiful women, men bring them back home and they find a dead body.		
	They are people in Toro kingdom that eat dead people. Those are spirits that stole coffin and bring them to people that eat dead bodies.		

Additional information 6a: Stories told about Rugamba tree by one person living in Sebitoli village (identified by four of the people that we interviewed as being particularly knowledgeable about Rugamba tree) and tree villagers, Kibale National Park, Uganda.

"It is very different from other trees; it was the only one like that. Only people who were initiated could tell you more, it was secret. People used to sacrifice there, to that tree, and asked it services. They also throw money and coins to that tree.

In 1958, the road constructors wanted to bypass the road besides that tree so they wanted it off. I went to enquire about what happened and they said it refused to be cut. They tried to eliminate it but in vain, even two machine drivers died from there. That is when they proved that it had spirits, may be evil spirits.

It used to cry when you tried to cut it and it cried blood when they cut it. They finally used dynamite, it is meant for busting stones and it finally worked. The workers displaced it from where it was. At the time, local people around here were sent away and they were not allowed to be at the site when they eliminated that tree. After it was pushed far away, people were allowed to be around. After three days, a young one came out and was produced from that main big tree. Up to now, it is still there. People used to sacrifice [money, poultry] for that tree. It used to talk like a person. When they were trying to cut it, an old woman came out of the tree. The Italians [The constructors] wanted to photo shoot it and it disappeared. It was in form of an old woman. She was just shooting and jumping from the tree. It is not possible that we know what it used to talk. People who were involved in eliminating the tree are the ones who know what it said since local people were never allowed to be around.

Now people are informed, they no longer believe in such spirits. People of long time are the ones who got involved in such spirits. Right now, it is not possible that people still sacrifice because the young generation is informed about religion; they are not interested in such evil spirits. They no longer believe in spirits of long times. The same applies to me, when I was young, I believed in it."

Three villagers said that the tree was talking while being cut but each informer had a different version of this speech: (1) the tree asked why it was being cut; (2) the tree asked not to be cut as well as its suckers (“Don’t cut me or my child”); (3) the tree asked to be cut instead of its suckers, as the Engote tree.

Additional information 6b: Story told about Engote tree by one person living in Sebitoli village (the same person identified by four of the people that we interviewed as being particularly knowledgeable about Rugamba tree), Kibale National Park, Uganda.

"There are different tree species around. I can tell you about Engote tree, where a bus crashed seven years ago. People wanted to cut that tree. They cut it all around but it failed to fall. The axe went through but it failed to fall down. It asked people to sacrifice two heads of people. Then a person disappeared from that area. After some good time, not very long, the tree felt down. Few weeks after falling down, a bus accident occurred. Almost eight people died, including white people who were in that Kalita bus [name of national company]. They were travelling from Kampala to Fort Portal. People who know think the tree and its spirit sacrificed for itself, even thought it was already cut. There are very weird trees with those kind of spirits in the area."

Additional information 6c: Story told about Engote tree by one person living in Kihingami village, Kibale National Park, Uganda.

"There was another tree as heading to the forest fragment outside the park. The Mukwano employees [Tea company] used to cut it, and the next day they would find it there, standing. They did it several times and even made sacrifice (goats, bloody animals) to please the tree spirit. After scarifying, they tried to cut it again and they found it standing again the next day. So next time they bought a bulldozer. They finally managed to apprut it. After some good time, a Kalita bus [name of a national company] got an accident at the exact same place where Engote used to be and many people died. So people think that Engote spirit sacrified for itself."