

Attitudes Towards Forest Elephant Conservation Around a Protected Area in Northern Congo

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Abstract

An assessment of local attitudes towards conservation can guide wildlife managers in the effective application of measurements to improve these perceptions. Here we conducted a quantitative questionnaire survey around a protected area in northern Congo surveying 314 households living in four villages around the Nouabalé-Ndoki National Park. We investigated the impact of the benefits of a conservation project (led by an international non-governmental organisation), the experience with human-elephant conflict and the respondents' socio-economic profile on local people's attitudes towards forest elephant conservation. Using multivariate analysis, we found overall positive attitudes towards elephant conservation with more positive answers in the village where a conservation project is based. Furthermore, people employed in the conservation project stated more positive attitudes compared to logging company employees farmers, natural resource users and people conducting other jobs. Experience of human elephant conflict negatively impacted people's perceptions. Socio-economic variables, such as ethnic group, education level or salary category had relatively little impact on people's responses. Qualitative statements largely supported the questionnaire results. We discuss our results in the light of the limits of attitude surveys and suggest further investigations to identify the activities needed to foster positive attitudes for elephant conservation in all villages around the Nouabalé-Ndoki National Park in partnership with the logging company.

Keywords: Attitudes, Congo, employment, FSC certification, human-elephant conflict, logging concession, protected area, rural livelihoods

INTRODUCTION

Tropical protected areas (PAs) and their buffer zones are increasingly becoming threatened due to anthropogenic pressures (Terborgh et al. 2002; Laurance and Peres 2006; Laurance et al. 2012; Tranquilli et al. 2014). Outside PAs,

wide-ranging terrestrial mammals often come into conflict with people, negatively impacting their livelihoods and creating hostility against wildlife conservation (Woodroffe and Ginsberg 1998; Woodroffe et al. 2005; Treves et al. 2006). In sub-Saharan Africa, crop raiding is considered the largest negative impact of wildlife (Naughton-Treves 1997; De Boer and Baquete 1998; Gillingham and Lee 1999; Webber et al. 2007; Hartter et al. 2011). When people's livelihoods are put under risk, support for wildlife conservation and nearby PAs is often compromised (Naughton-Treves 2001; Sitati et al. 2005; West et al. 2006; Parker et al. 2007). However, support from communities living in proximity of PAs is crucial for the success of conservation objectives (Hackel 1999; Treves et al. 2006; Adams and Hutton 2007).

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Due to their wide-ranging behaviour, African elephants *Loxodonta spp.* regularly come into conflict with people (Naughton-Treves 1997; Hill 2004). Human-elephant conflict (HEC) is a widespread problem and a well-studied topic in the management of the African savannah elephant *Loxodonta africana* (Hoare 2012, 2015). Crop raiding by elephants can severely impact local livelihoods and additionally, causes increased labour costs, heightened levels of stress and creates fear (Lee and Graham 2006; Walker 2012). When elephants raid crops, they may destroy an entire field leaving long-lasting negative attitudes (Nchanji and Lawson 1998). HEC can result in the abandonment of fields and leads to less tolerance for elephants (Hill 2004; Gadd 2005; Parker et al. 2007). Community members use their voice to complain about other land and resource use issues and the debate can become highly political and in some cases to the killing of elephants (Tchamba 1995; Lee and Graham 2006).

HEC involving Forest elephants *Loxodonta cyclotis* has been well studied in West Africa (Boafo et al. 2004; Gunn et al. 2014; Barnes et al. 2015) but remains far less studied in Central Africa (Barnes 1996). Forest elephants in Central Africa have undergone dramatic declines due to poaching (Maisels et al. 2013). Their habitat is also undergoing rapid land use conversions due to palm oil, mining, and infrastructure development (Edwards et al. 2014; Wich et al. 2014; Laurance et al. 2015). These anthropogenic threats likely compress forest elephants into PAs and areas where they feel safe (Yackulic et al. 2011) potentially leading to heightened HEC (Breuer et al. 2016). In northern Congo, forest elephants still roam freely in relatively intact forest blocks of PAs and sustainably managed logging concessions, albeit they have also seen substantial declines due to poaching (Maisels et al. 2013). Forest elephant numbers in northern Congo are stable within the Nouabalé-Ndoki National Park (NNNP) but have been declining outside of NNNP (Maisels et al. 2012). Estimates of forest elephant numbers outside NNNP are shown in Table 1. While the area is still relatively sparsely populated by people, it has seen anthropogenic changes due to increased infrastructure development (notably roads, logging camps, and agricultural activities) associated with the expansion of logging road networks and the subsequent encroachment by people (Laporte et al. 2007; Kleinschroth et al. 2015) that are likely to continue to increase in the near future. Over the last two decades, the communities in northern Congo have undergone significant socio-economic transformations due to expansion of commercial forestry and immigration from urban centres and neighbouring countries undergoing civil unrest resulting in dramatic changes of local economies and community politics (Poulsen et al. 2009; Clark and Poulsen 2012; Riddell 2013). This is likely to change traditional attitudes towards wildlife conservation, a subject that has rarely been investigated in Central Africa.

Understanding local people's attitudes can help to inform PA managers whether positive or negative opinions towards wildlife and PAs exists and which factors influence them might (Naughton-Treves and Treves 2005; Fishbein and Ajzen 2010;

St. John et al. 2010; Ajzen 2012; Bennett 2016). Therefore, a rigorous assessment of attitudes towards conservation and the underlying factors building these attitudes helps to assess the success of existing and guiding new conservation policies (Infield 1988; Gillingham and Lee 1999; Holmes 2003; Anthony 2007; Dickman 2010; Hartter and Goldman 2011; St. John et al. 2013).

Local people's attitudes are largely shaped by the impacts, both positive and negative, of having wildlife close by, and these vary among social and economic groups (Newmark et al. 1993; Fiallo and Jacobson 1995; Holmes 2003; Anthony 2007; Shibia 2010; Sodhi et al. 2010; Hartter and Goldman 2011; Snyman 2014). Negative attitudes might be particularly prominent due to the costs of natural resource use restrictions within the PA and due to HEC (Parry and Campbell 1992; De Boer and Baquete 1998; Gillingham and Lee 1999; Gadd 2005; Anthony 2007; Kideghesho et al. 2007; Hartter and Goldman 2011; Snyman 2014). Under these circumstances, poorer households and those who largely depend on agriculture are expected to have more negative attitudes as they are less able to cope with HEC. Unequal distribution of PA benefits, less regular visits by conservation project staff, and potentially undelivered promises might further negatively affect attitudes (Gadd 2005).

Often the negative impacts are compensated by conservation projects through their contribution to rural development, which can improve local attitudes and behaviour in support of PAs and wildlife conservation (Heinen 1996). Favourable attitudes might also occur due to access to natural resources, ecosystem services (e.g., water quality, climate maintenance), but are largely shaped by financial benefits such as employment, tourism revenue, or development initiatives in the community, such as health and education services (Infield 1988; Lewis et al. 1990; Newmark et al. 1993; Sodhi et al. 2010; Hartter and Goldman 2011; Brooks et al. 2013; Hartter et al. 2014; Snyman 2014). For example, preferential employment of local people in a conservation project or perceiving the advantages of a nearby conservation project is likely to influence attitudes at the community level if a high proportion of households in the village/community can access those benefits (Infield 1988; Snyman 2014).

Social and other economic factors, such as gender, ethnic group, and the level of education, occupation, or wealth are likely to influence attitudes towards PAs and wildlife, as these factors are linked closely to how people experience conservation impacts. However, given the complex nature of rural societies these links often vary between sites as there are differences in social norms in and between communities as well as differing benefits and risks (Infield 1988; Hill 1998; Gadd 2005; Allendorf et al. 2006; Anthony 2007; Kideghesho et al. 2007; Browne-Nuñez et al. 2013; Hartter et al. 2014; Snyman 2014).

In this study, we conducted a questionnaire survey to understand the factors shaping attitudes towards forest elephants in northern Congo as a first step to orientate management of HEC, and to test, if the presence of a long-term

Table 1

Socio-economic details of villages investigated during the current study around Nouabalé-Ndoki National Park, northern Congo (estimates of forest elephant numbers are from Stokes et al. 2010 and Maisels et al. 2012)

Name of village	Bomassa	Makao	Kabo	Loundougou
Size of human population	663	744	2608	> 1000
Location	Kabo logging concession, 30 km from Nouabalé-Ndoki National Park; 1 km from other Sangha Trinational parks	Ipendja logging concession, 40 km from Nouabalé-Ndoki National Park	Kabo concession, 50 km from Nouabalé-Ndoki National Park; 1 km from other Sangha Trinational parks	Loundougou-Toukoulaka logging concession, 20 km from Nouabalé-Ndoki National Park
History	Bushmeat and ivory trading settlement in the early twentieth century	Hunter-gatherer and agriculture settlement; during colonial times located in Nouabalé-Ndoki National Park	Small fishing village grown in size due logging operation and then closure of saw mill	Logging camp created in 2004 in the middle of the forest and rapid population increase due to logging company employees, their relatives and local hunters
Type of village	Conservation village/hunting activities	Conservation village/nearby logging town/hunting activities	Logging activities/hunting town/conservation project of NNNP buffer zone	Logging camp/hunting activities
Benefits from conservation project	Preferential employment, school bursaries, health services, all-year hunting permitted	Preferential employment, health services	Preferential employment, some social services, alternative protein projects in the past	None
Typical employment	Conservation project, natural resource extraction (mainly hunting and fishing), self employed	Logging company, conservation project, nearby logging company resource extraction, self-employed, agriculture	Logging company, conservation project, resource extraction, self-employed, agriculture	Logging company, resource extraction, self-employed, agriculture
Agricultural activity	Almost absent since return of elephants to village in the mid-90s	Medium	Little to medium	Medium
Forest elephant population size estimate (survey from 2006 and 2010/2011)	2084/1692 (Kabo logging concession)	No estimate available, but elephant numbers in Mokabi-Dzanga concession assumed to be low	2084/1692 (Kabo logging concession)	1652/291 (Loundougou logging concession)
Degree of human-elephant conflict (HEC)	High	Medium	Medium	
Number of households interviewed	96	52	102	64
Proportion of households interviewed	73%	47%	17%	54%

conservation project has fostered positive attitudes. The aims of our study were to understand the attitudes of local people living around NNNP in northern Congo, and how the benefits and costs of having wildlife and a conservation project nearby might shape these attitudes. NNNP is a large tropical rainforest PA, surrounded by a few villages, that has received substantial long-term conservation support over the last 25 years. The largely intact forest surrounding NNNP contains only a few villages, and are a prime habitat for forest elephants which range largely undisturbed through the landscape. The forest also provides an important livelihood and socio-cultural heritage for BaAka hunter-gatherers. NNNP is bordered by sustainably managed logging concessions which hold timber certification (Forest Steward Council (FSC)) and include biodiversity conservation in their agenda (mostly through land use planning

and wildlife management) (Clark and Poulsen 2012). While elephant conservation is in common of both, PA and logging concessions as their killing is strictly prohibited, the different households and communities do not receive the same benefits from conservation (such as revenue sharing from tourism, infrastructure development, education, and health services). The conservation project and benefits are only present in two of the principle four villages ('conservation village') around NNNP, although the other villages/settlements receive benefits from the logging companies. However, the costs of HEC might be considered similar due to the free-ranging nature of forest elephants in the area. With many people employed by either conservation project or logging companies and substantial differences in benefits between villages, we paid particular attention to whether or not the respondents worked in the

conservation project or lived in the conservation village, and its link to their conservation attitudes. Thus, we predicted to find more positive attitudes in the conservation villages and in relation to employment in the conservation project. Similarly the costs due to HEC might differ due to localised high elephant abundance and compression due to poaching in other zones (Breuer et al. 2016), and we predicted that local communities experiencing more costs (heightened HEC) are less likely to support forest elephants. Likewise, people, whose livelihoods are more dependent on agriculture, are expected to have more negative attitudes because of the greater risks and potential losses they might face.

MATERIALS AND METHODS

Study Area

NNNP, created in 1993 and extended in size in 2012, is a part of the larger Sangha-Trinational world heritage site, that is known for its pristine rainforest and large populations of forest elephants and great apes (Figure 1). It is co-managed by the Ministry of Forest Economy and Sustainable Development and the Wildlife Conservation Society (WCS) with a particular emphasis on local participation and co-management (Ruggiero 1998). Recently a public-private partnership agreement between the two partners has been signed that has given the PA management authority to WCS (Hatchwell 2014).

Additionally a partnership between the Ministry, WCS, and a logging company ensures the management of several logging concessions surrounding NNNP where reduced impact logging, law enforcement, and revenue sharing are practised (Clark and Poulsen 2012).

Study population

We chose the four closest settlements around NNNP (within 50 km of NNNP and with at least 100 inhabitants) (see Figure 1) to study the attitudes of the resident people towards PAs and elephants. The four study villages varied in their involvement in conservation and logging activities: 1) Bomassa, a conservation-focussed village; 2) Makao, a conservation-focussed village but with less employment opportunities and a nearby logging company; 3) Kabo, originally a logging town now focussed on agriculture and presence of a conservation project to manage the buffer zone of NNNP; and 4) Loundougou which is a logging camp installed in the middle of the rain forest (summarised in Table 1). The settlements contain a mixture of people of varying origin and socio-economic background, with various traditional groups of Bamenjele and Bangombe Aka hunter-gatherers, and Bantu-speaking farmer-fisher, and immigrants working for the logging company, conservation project or in other businesses (Tables 1 and 2). Agricultural activities are expanding with the principal crops being cassava *Manihot esculenta*, maize

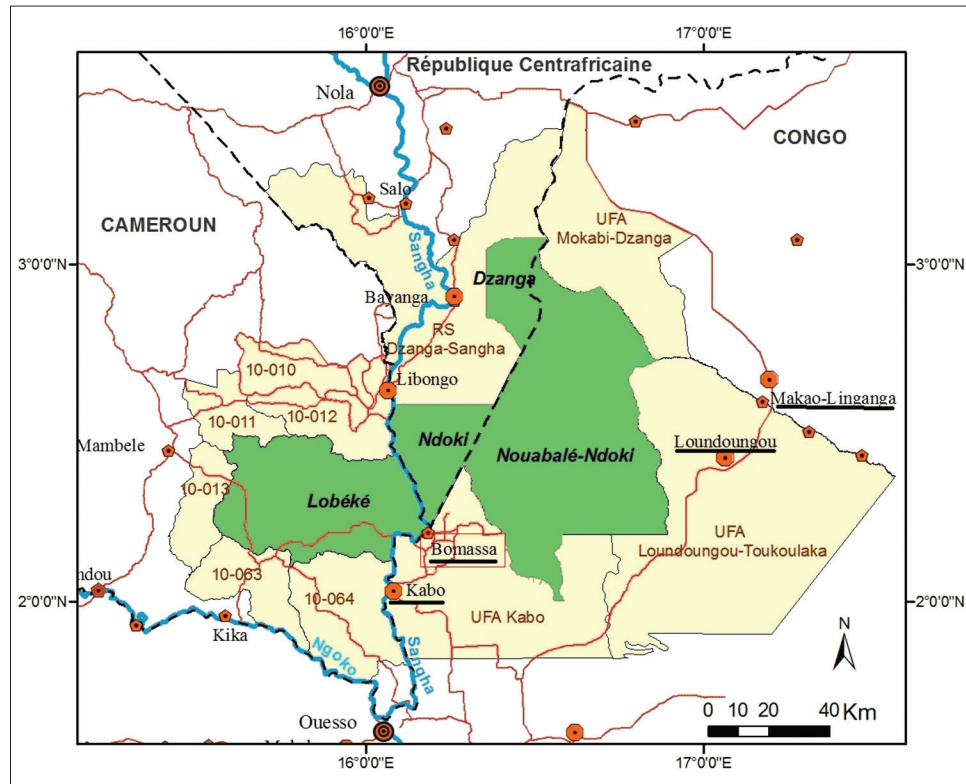


Figure 1

Location of study villages (Bomassa, Makao, Kabo, Loundougou) around Nouabalé-Ndoki National Park (NNNP) in northern Congo: The Sangha Trinational world heritage site includes NNNP and the national parks in Cameroon (Lobéké National Park) and the Dzanga-Ndoki National Park in the Central African Republic. UFA indicates logging concession (map by Patrick Boundja / WCS)

Table 2
Socio-demographic context (job, ethnic group,) of respondents residing in the four different study villages around NNNP

	Bomassa (n=96 with 67 responses for the second job question)	Makao (n=52 with 39 responses for the second job question)	Kabo (n=102 with 83 responses for the second job question)	Loundoungou (n=64 with 53 responses for the second job question)
# employed in conservation as 1 st /2 nd job	89/2	16/1	20/1	0/0
# working in natural resource use as 1 st /2 nd job	7/47	2/9	21/33	0/6
# employed in logging as 1 st /2 nd job	0/0	9/0	12/0	61/0
# working in farming as 1 st /2 nd job	0/2	15/22	26/25	3/41
# working in other business as 1 st /2 nd job	0/16	10/7	23/24	0/6
# Aka/Bantu	47/49	6/46	38/64	5/59
# no/primary/secondary/higher education	17/42/27/10	7/22/22/1	25/36/36/5	0/10/52/2
# income category 1/2/3	0/77/19	1/40/11	26/67/9	0/35/29
# experienced HEC	66	41	55	47

Zea mays, bananas *Musa spp.*, fruiting trees, vegetables, and occasionally pineapple *Ananas comosus*.

Bomassa is considered a conservation village that largely benefits from the employment opportunities at the nearby NNNP headquarters (see Table 1; Ruggiero 1998; Eves and Ruggiero 2000). Before the establishment of the NNNP headquarters in Bomassa in 1991, elephants were absent from the village as ivory poaching was common. Agricultural activities and fishing also occurred for subsistence with almost every household having a small farm; manioc field sizes were related to household wealth (Eves 1995). Crop raiding was uncommon and the few subsistence farmers had no complaints. However with increased protection, elephants became accustomed to the village and HEC increased (Madzou 1999; Ongognongo et al. 2006). Today people living in Bomassa have largely given up agriculture and rely on imported cassava that is subsidised by the conservation project (Dos Santos and Breuer 2012). Wildlife populations around the village are largely intact (Maisels et al. 2012) and nearby poaching events are relatively rare.

Makao, the second base of NNNP is also considered a conservation village, but compared to Bomassa receives fewer employment opportunities. With the installation of a logging camp (Thanry-Congo; around 2,500 people) just 5 km from Makao and the road and bridge construction in 2006 to connect Makao with the Pokola logging town, dramatic changes in livelihood activities occurred. Many Aka moved to the nearby logging town as gun hunters, collectors of non-timber forest products, or helpers on farms for new company employees (Riddell 2013). An overall commercialisation of bushmeat as well as dramatic increase in ivory poaching occurred in the following years, leading to significant drops in wildlife numbers, including elephants in the area (Stokes et al. 2010; Maisels et al. 2012). HEC occurs but due to the common poaching practices, elephants appear to largely avoid fields close to the village.

The Kabo town was originally dominated by Bantu households with a small Aka settlement nearby (Eves 1995). The dynamics of the human population in Kabo were mainly

determined by the operation of logging activities that started in the 1960s. The small village has grown substantially due to timber extraction, resulting in the dominance of immigrants in regards to wealth, bushmeat consumption, and trade (Poulsen et al. 2009). Furthermore a conservation project to ensure the sustainable use of the buffer zone around NNNP has been installed in Kabo in 1999 providing employment opportunities (Elkan et al. 2006; Clark and Poulsen 2012). The logging company provides favourable living conditions, such as brick houses, access to clean water and electricity, access to the hospital and pharmacy, as well as free transportation to Pokola. In 2009, the logging company closed the saw mill in Kabo, resulting in the redundancy of more than 650 workers. Remaining inhabitants conduct a diversity of activities, including agriculture. HEC appears to be increasing with the return of elephants due to improved protection.

Loundoungou logging camp was constructed in 2004 in the south-east of NNNP in the middle of a pristine rain forest. A saw mill has subsequently been constructed and the logging company workers and their families quickly attracted local hunters and the total population quickly reached more than 1,000. The same advantages as seen in Kabo occur in Loundoungou. Agriculture is largely practised by family members of logging company employees outside the workers camp in the rain forest. Unsustainable hunting practices have resulted in dramatic decline of ungulates in the Loundoungou logging concessions. HEC is considered low as elephant density in the area is low and illegal human activities are common (Maisels et al. 2012).

Survey methods

We interviewed 314 people residing in the four different villages as part of investigations into the impact of human-wildlife conflict. Here we present the results of the attitude survey. The first author lived for almost two years in Bomassa and made various excursions to the other villages to become familiar

with the local livelihoods and to establish a good relationship with residents to reduce response bias (e.g., increase truthful responses) (e.g., Browne-Nuñez and Jonker 2008). Interviews were performed by the first author, along with two assistants who were trained in interview methodology prior to starting the study. The assistants were familiar with the households in various villages as they have either lived there for more than a year or worked for the conservation project. We sought free, prior, and informed consents with all participants in the survey. One day prior to the survey we approached the village chief and elders for permission to conduct the interviews. We used existing demographic data from our long-term annual census to ensure we sampled at least 10% of the households in each village. Whenever possible, we selected households randomly and approached when the household head was likely to be at home. We walked through the village and approached one member of the household, mostly commonly the male household owner, and asked whether he/she was willing to participate in the survey. If the household head was not available, the spouse or any member of the household older than 18 years was permitted to take part in the survey. Occasionally, no one was present at the domicile so we tried to meet the person directly on his/her way back to home from work, field, or hunting trip without disturbing his/her actual activity, or passed by the domicile during the following day. Interviews were carried out between February and December 2014, between 07:00–18:00, took around 20–45 minutes to complete, and were held in local languages. We used a semi-structured interview which also allowed us to collect supporting qualitative information to the responses. The questionnaire included seven close-ended questions about attitudes towards elephants and was complemented by socio-economic information of the respondent.

Data analysis

We performed a multivariate analysis to examine the effect of various socio-economic co-variables and their interactions on the responses of the questionnaire. Specifically we ran generalised linear models (GLM) to see which variables were most important in determining responses to our key questions about attitudes to elephants (details of explanatory variables in Table 3). Income and education were ordinal predictors (treated as linear for analyses) while the other predictors were binary. Due to high-collinearity (as revealed by variance inflation factor) between village and job we excluded village as co-variable in the GLM, but also present effect of village separately for each question. Additionally we included some interactions while other interactions could not be included because of multi-collinearity. The response variables to the key questions indicated whether respondents answered *yes*=1 or *no*=0, so each model was fitted with a binomial error structure and logit link. All models were run in R (R Development Core Team 2014). We obtained the best fit GLM using Akaike's information criteria (AICc) (Burnham et al. 2011) by applying the dredge function in the MuMin package (Barton 2015) and present the top selected sub-models with a threshold

criterion of $\Delta AICc < 2$ as well as relative importance ($> 50\%$) of the explanatory model using the importance function in the MuMin package. For the best model we provide significance of co-variables and present estimate, standard deviation, Wald statistic (z -value), and variable significance (p -value) (for further details see Burnham et al. 2011 and Table 4).

RESULTS

Survey results

The majority of the 314 respondents were male (75%) and ethnically Bantu (69%). Primary employment differed substantially between the villages with conservation dominating in Bomassa (93%) and Makao (31%), farming (25%) and other (trading, transport, food, and alcohol production) (23%) activities in Kabo and logging company workers were dominant in Loundoungou (95%). The majority of workers engaged in the conservation project (42%), conducting farming activities (43%), and natural resource users (40%) had primary school education, whereas people working for the logging company (77%) and conducting other activities (61%) had primarily secondary school education, whereas above secondary level education was rare. 77% ($n=242$) of respondents had a secondary livelihood. The most common secondary livelihood was natural resource use (39%; $n=95$), followed by farming (37%; $n=90$), other activities (22%; $n=53$) and working in a conservation project (2%; $n=4$). For those who primarily worked in a conservation project, their most stated secondary activity was natural resource use (61%; $n=58$); those working for the logging company conducted farming as their main secondary activity (75%; $n=47$); farmers often conducted other activities as a second job (58%; $n=19$). In Bomassa and Kabo, the majority of households used natural resources as a second income, whereas farming was the main secondary job in Makao and Loundoungou (Table 2). 41% ($n=129$) of people stated that they practised agriculture to some extent. Around 70% ($n=219$) had an income between XAF 50 and XAF 100,000, whereas low salary income was stated in 9% ($n=27$) of the cases, and 21% ($n=68$) had Income of more than XAF 100,000 or approximately USD 190 (average income in the country approximately XAF 50,000). Experience of HEC was high (67%; $n=209$) and differed between villages (highest in Loundoungou and lowest in Kabo), and between job with 100% of farmers having conflict, followed by logging company employers (78%), and lowest for other job category (49%).

Attitudes towards elephants and protected areas (PAs)

We found substantial differences between villages, job, and whether or not people experienced HEC, and to some extent ethnic group, income, and education but explanatory variables in best models varied substantially between questions (summarised in Tables 3, 4, 5, and 6).

Question 1: Are you afraid of elephants? The majority of people (74%) stated they were afraid of elephants, particularly

Table 3
Responses to the seven questions in regard to the different explanatory variables

Explanatory variable	Details of variable	Are you afraid of elephants? Yes/No	Do you like to see the pictures of elephants, without feeling the desire to see them in the wild? Yes/No	Do you like to have some information on the conservation of elephants? Yes/No	Are you happy when you see the photos of a killed elephant? Yes/No	Are you happy when they arrest someone that killed an elephant? Yes/No	Do you think alone the conservationists are sensitive to the elephants and not the Congolese people? Yes/No	Do you think that elephants have the right to live in your area? Yes/No
<i>Village</i>	<i>Bomassa</i>	83/13	14/82	90/6	12/82	80/16	24/72	90/4
	<i>Makao</i>	32/20	16/36	40/12	24/78	52/44	30/21	44/8
	<i>Kabo</i>	72/30	28/74	58/44	8/44	42/10	47/55	89/11
	<i>Loundoungou</i>	46/18	26/38	47/17	12/52	38/26	42/22	57/4
<i>Job</i>	<i>Conservation project</i>	94/31	18/107	114/11	14/111	102/23	35/90	117/5
	<i>Farming</i>	32/12	14/30	23/21	13/31	23/15	22/21	34/10
	<i>Logging company</i>	61/21	31/51	60/22	13/69	53/29	52/30	70/9
	<i>Natural resource user</i>	21/9	6/24	18/12	5/25	16/14	17/13	29/1
	<i>Other</i>	25/8	15/16	20/13	11/22	18/15	17/16	30/2
<i>Ethnic group</i>	<i>Aka</i>	72/24	9/87	75/21	13/83	68/28	37/59	88/7
	<i>Bantu</i>	161/57	75/143	160/58	43/175	144/68	106/111	192/20
<i>Education</i>	<i>None</i>	37/12	6/43	32/17	11/38	29/20	18/30	43/6
	<i>Primary school</i>	78/32	20/90	89/21	16/94	83/25	37/73	99/9
	<i>Secondary school</i>	106/31	52/85	98/39	29/108	85/48	79/58	120/12
	<i>University</i>	12/6	6/12	16/2	0/18	15/3	9/9	18/0
<i>Income</i>	<i>< 50,000 XAF-1 US\$=526 XAF: (15 December 2014: http://www.xe.com)</i>	17/10	5/22	18/9	8/19	13/14	12/15	23/3
	<i>50-100,000 XAF</i>	168/51	60/159	158/61	33/186	152/62	98/120	194/19
	<i>> 100,000 XAF</i>	48/20	19/49	59/9	15/53	47/20	33/35	63/5
<i>Experienced HEC</i>	<i>Yes</i>	160/49	32/73	89/16	12/93	75/30	39/66	94/6
	<i>No</i>	73/32	52/157	146/63	44/165	137/66	104/104	186/21

people residing in Bomassa. Bomassa had significantly more yes answers compared to Makao, Kabo, and Loundoungou, likely reflecting more encounters with potentially dangerous elephants in Bomassa (Table 6). Accordingly one respondent in Bomassa stated: “I fear elephants because they can be chasing and killing you”. The most important variables were ‘experienced HEC’ (selected in 72% of models) and ‘ethnic group’ (52%). The best model included the variables ‘experienced HEC’ and ‘ethnic group’ as well as an interaction effect between both (Tables 4 and 5).

Question 2: Do you like to see the pictures of elephants, without feeling the desire to see them in the wild? The majority of respondents (73%) stated that they like to see elephants in the wild, not just in a photo. Again, we found more interest among Bomassa people (Table 6). The variable ‘ethnic group’ was selected in 96% of models, followed by ‘job’ (85%), ‘experienced HEC’ (76%), and ‘education’ (56%). The best model included the first three variables. In this model, Bantus had significantly less interest to actually see elephants compared to Aka and people in job category farming, logging company, and other also had less interest to see elephants compared to

people working in the conservation project (Tables 4 and 5). Respondents who were not keen to see elephants in the wild made the following statements: “The elephant is an animal, a protein resource and we cannot love them like a human being” (women from Makao). “White people put more importance on elephants than on people that is why I don’t want to see elephants” (farmer from Loundoungou). “Did the elephant become a human being or why do you make such comparisons” (worker for logging company in Kabo).

Question 3: Do you like to have some information on the conservation of elephants? The majority of respondents (75%) stated that they would like to have more information on the conservation of elephants. Again, we found people from Bomassa showing more interest compared to the other three villages (Table 6). The highest rankings of relative importance of explanatory variable were for ‘job’ (100%), ‘experienced HEC’ (98%), ‘income’ (88%), and ‘education’ (58%). In the best model, respondents not working for the conservation project showed less interest to get further information on elephant conservation. People that were experiencing HEC were less interested to get further information, , whereas

Table 4

Results of general linear model of responses to elephant conservation related to seven questions. Best models are shown in bold with estimate and standard estimation, z-and P value, degrees of freedom (df), logLink, AICc and $\Delta AICc$ of each model within $\Delta AICc < 2$ of the best model

Question	Model	df	logLink	AICc	$\Delta AICc$
Are you afraid of elephants?	Ethnic group+Experience HEC+Ethnic group* Experience HEC	4	-175.81	359.7	0
	Full model	1	-179.27	360.5	0.8
	Experience HEC	2	-178.38	360.8	1.05
Do you like to see the pictures of elephants, without feeling the desire to see them in the wild?	Education+Ethnic group+Experience HEC+Ethnic group* Experience HEC	5	-175.77	361.7	1.98
	Ethnic group+Experienced HEC+Job	7	-162.5	339.4	0
	Ethnic group+Experienced HEC+Job+Education	8	-161.63	339.7	0.37
	Ethnic group+Experienced HEC+Job+Education+Income	9	-160.96	340.5	1.14
	Ethnic group+Experienced HEC+Job+Ethnic group*Experienced HEC	8	-162.07	340.6	1.24
	Ethnic group+Experienced HEC+Job+Income	8	162.129	340.7	1.37
	Ethnic group+Job	6	-164.3	340.9	1.5
	Ethnic group+Job+Education	7	-163.36	341.1	1.71
	Ethnic group+Experienced HEC+Job+Education+Ethnic group*Experienced HEC	9	-161.25	341.1	1.73
	Ethnic group+Job+Education+Income	8	-162.43	341.3	1.97
Do you like to have some information on the conservation of elephants?	Experienced HEC+Income+Education+Job+Education* Experienced HEC	9	-149.44	317.5	0
	Experienced HEC+Income+Job	7	-151.89	318.2	0.68
	Experienced HEC+Income+Education+Job+Ethnic group+Education*Experienced HEC	10	-149.3	319.3	1.85
Are you happy when you see the photos of a killed elephant?	Job+Income+Experienced HEC+Job*Income	11	-131.33	285.5	0
	Job+Income+Experienced HEC+Education+Job*Income	12	-130.51	286	0.51
	Job+Income+Experienced HEC+Education+Ethnic group+Job*Income	13	-129.86	286.9	1.39
	Job+Income+Job*Income	10	-133.29	287.3	1.76
Are you happy when they arrest someone that killed an elephant?	Job	5	-181.91	374	0
	Job+Income	6	-181.43	375.1	1.13
	Job+Education	6	-181.67	375.6	1.6
	Job+Experienced HEC	6	-181.74	375.8	1.75
Do you think alone the conservationists are sensitive to the elephants while the other Congolese people don't care?	Education+Experienced HEC+Job	7	-196.48	407.3	0
	Education+Experienced HEC+Ethnic group+Job	8	-195.5	407.5	0.14
	Education+Experienced HEC+Job+Income	8	-195.84	408.2	0.83
	Education+Job	6	-198.23	408.7	1.41
	Education+Experienced HEC+Job+Education*Experience HEC	8	-196.16	408.8	1.47
	Education+Ethnic group+Experienced HEC+Job+Income	9	-195.13	408.8	1.52
Do you think that elephants have the right to live in your area?	Education+Ethnic group+Experienced HEC+Job+Education*Experienced HEC	9	-195.13	408.9	1.53
	Job+Education	6	-83.096	178.5	0
	Job	5	-84.334	178.9	0.4
	Job+Income	6	-84.733	179.7	1.27
	Job+Income+Education	7	-82.909	180.2	1.72
	Job+Ethnic group	6	-83.998	180.3	1.8

those with higher income showed more interest. We also found a significant interaction of variables 'education' and 'experienced HEC' indicating that less educated people with more HEC showed less interest to learn more about elephants.

Some people stated that it is not important to get further information other said that "Elephants cause a lot of conflict, therefore why should I need more information on them" (farmer from Makao).

Table 5

Comparison of variables within the best selected model. Positive estimates indicate a positive association between explanatory variable (s) and response and the z-value the strength of that association and the P value correspond to those z-values in a standard normal distribution (significant results shown in bold)

Question	Variable comparison of best model	Estimate±SE	z	p
Are you afraid of elephants? Best model: Ethnic group+Experience HEC+Ethnic group* Experience HEC		0.486±0.318	1.528	
	Bantu	0.592±0.430	1.377	0.168
	Experienced HEC	1.264±0.498	2.539	0.011
	Bantu*Experienced HEC	-1.319±0.604	-2.184	0.029
Do you like to see the pictures of elephants, without feeling the desire to see them in the wild? Best model: Ethnic group+Experienced HEC+Job		-2.490±0.445	-5.598	<0.001
	Bantu	1.526±0.430	3.546	<0.001
	Farming	0.937±0.446	2.099	0.036
	Logging company	0.977±0.358	2.726	0.006
	Natural resource user	0.936±0.575	1.628	0.104
	Other	1.232±0.448	2.754	0.006
	Experienced HEC	-0.583±0.308	-1.893	0.058
Do you like to have some information on the conservation of elephants? Best model: Experienced HEC+Income+Education+Job+Education*Experienced HEC		2.322±0.860	2.700	
	Farming	-1.857±0.451	-4.115	< 0.001
	Logging company	-1.617±0.438	-3.691	< 0.001
	Natural resource user	-1.801±0.534	-3.371	< 0.001
	Other	-2.029±0.512	-3.963	< 0.001
	Experienced HEC	-2.383±0.776	-3.070	0.002
	Higher Education	-0.653±0.399	-1.638	0.101
	Higher Income	0.823±0.338	2.434	0.015
	Less Education and more HEC	0.941±0.438	2.146	0.032
Are you happy when you see the photos of a killed elephant? Best model: Job+Income+Experienced HEC+Job*Income		-4.296±1.466	-2.930	
	Experienced HEC	0.796±0.419	1.899	0.058
	Higher Income	0.765±0.606	1.262	0.207
	Farming	4.746±2.252	2.107	0.035
	Logging company	-2.402±2.414	-0.995	0.320
	Natural resource user	4.475±2.103	2.128	0.033
	Other	5.408±2.019	2.679	0.007
	Higher income * Farming	-1.817±1.066	-1.705	0.088
	Higher income * Logging company	0.960±0.940	1.021	0.307
	Higher income * Natural resource user	-2.203±1.170	-1.883	0.060
	Higher income * Other	-1.948±0.963	-2.024	0.043
Are you happy when they arrest someone that killed an elephant? Best model: Job		1.489±0.231	6.453	
	Farming	-1.062±0.404	-2.627	0.009
	Logging company	-0.887±0.327	-2.715	0.007
	Natural resource user	-1.356±0.433	-3.134	0.002
	Other	-1.307±0.419	-3.120	0.002
Do you think alone the conservationists are sensitive to the elephants while the other Congolese people don't care? Best model: Education+Experienced HEC+Job		-1.786±0.357	-4.997	
	Higher education	0.385±0.166	2.320	0.020
	Experienced HEC	0.509±0.273	1.860	0.063
	Farming	0.878±0.383	2.293	0.022
	Logging company	1.292±0.315	4.097	< 0.001
	Natural resource user	1.469±0.441	3.334	< 0.001
	Other	0.982±0.413	2.378	0.017
Do you think that elephants have the right to live in your area? Best model: Job+Education		2.635±0.540	4.880	
	Higher education	0.470±0.303	1.549	0.121

Contd...

Table 5
Cond...

Question	Variable comparison of best model	Estimate±SE	z	p
	Farming	-1.909±0.585	-3.261	0.001
	Logging company	-1.434±0.632	-2.270	0.023
	Natural resource user	0.411±1.123	0.366	0.714
	Other	-0.632±0.876	-0.722	0.470

Table 6

Result of GLM with a single variable village. Positive estimates indicate a positive association between explanatory variable (s) and response and the z-value the strength of that association and the P value correspond to those z-values in a standard normal distribution (significant results shown in bold)

Question and village	Estimate±SE	z	p
Are you afraid of elephants?	1.854±0.298	6.215	< 0.001
Kabo	-0.978±0.369	-2.651	0.008
Loundoungou	-0.916±0.408	-2.246	0.025
Makao	-1.384±0.413	-3.354	< 0.001
Do you like to see the pictures of elephants, without feeling the desire to see them in the wild?	-1.768±0.289	-6.113	< 0.001
Kabo	0.796±0.365	2.183	0.029
Loundoungou	1.388±0.385	3.604	< 0.001
Makao	0.957±0.417	2.294	0.022
Do you like to have some information on the conservation of elephants?	2.708±0.422	6.423	< 0.001
Kabo	-2.432±0.467	-5.211	< 0.001
Loundoungou	-1.691±0.508	-3.330	< 0.001
Makao	-1.504±0.535	-2.812	0.005
Are you happy when you see the photos of a killed elephant?	-1.946±0.309	-6.305	< 0.001
Kabo	0.767±0.387	1.983	0.047
Loundoungou	0.480±0.445	1.078	0.281
Makao	0.241±0.493	0.489	0.625
Are you happy when they arrest someone that killed an elephant?	1.609±0.274	5.877	< 0.001
Kabo	-1.442±0.342	-4.218	< 0.001
Loundoungou	-1.230±0.374	-3.290	0.001
Makao	-0.174±0.446	-0.391	0.696
Do you think alone the conservationists are sensitive to the elephants while the other Congolese people don't care?	-1.099±0.236	-4.661	< 0.001
Kabo	0.941±0.308	3.054	0.002
Loundoungou	1.745±0.353	4.940	< 0.001
Makao	1.455±0.370	3.939	< 0.001
Do you think that elephants have the right to live in your area?	3.114±0.511	6.094	< 0.001
Kabo	-1.023±0.603	-1.697	0.090
Loundoungou	-0.457±0.727	-0.628	0.530
Makao	-1.409±0.639	-2.203	0.028

Question 4: Are you happy when you see the photos of a killed elephant? The majority of respondents (82%) stated that they are not happy when they see a killed elephant, with people from Kabo having more negative attitudes compared to people from Bomassa (Table 6). The explanatory variables with the highest relative importance were 'job' (98%), 'income' (91%), 'experienced HEC' (82%), an interaction of variables 'job' and 'income' (79%) and 'education' (57%). In the best model, respondents with job category 'farming', 'natural resource user' and 'other', had significantly less positive attitudes compared to people employed in the conservation project (Tables 4 and 5). Those respondents that have experienced HEC showed a trend of less positive attitudes compared to those without HEC. We also found a significant interaction of variables 'job' and 'income' indicating that those with higher income working in

the conservation project had more negative attitudes while the opposite was true for the interaction farming and income, natural resource user and income and other and income (Table 5).

Question 5: Are you happy when they arrest someone that killed an elephant? A large proportion of respondents (69%) stated yes, but people from Kabo and Loundoungou had less positive attitudes (Table 6). Only the variable 'job' (99%) had a relative importance in more than 50% of models and only the variable 'job' was included in the best model with all categories having less positive attitudes compared to those respondents working in a conservation project (Tables 4 and 5). Farmers from Loundoungou stated: "If an elephant is killed in the forest the person should be arrested, but if you arrest a farmer who killed an elephant in his field, then this is not right"; "the elephant is just an animal so you can kill it".

Question 6: Do you think alone the conservationists are sensitive to the elephants while the other Congolese people don't care? Only around half of respondents (54%) stated that this is not true. The following variables were of relative importance: 'job' (100%), 'education' (93%), 'experienced HEC' (83%) and 'ethnic group' (50%). In the best model we found people working for the conservation project recognised more often that Congolese also care about conservation whereas respondents with higher education stated the opposite. Frequent replies included: "Many think that the white people who came to protect the animals, such as elephants and gorillas are actually looking for other natural resources such as gold and diamonds" (worker of the conservation project) or: "Local conservation authorities have started to care more about elephants and gorillas than about the local people" (farmer from Kabo and Loundoungou). "Other people get benefits from protecting these animals but not the local population" (various sources).

Question 7: Do you think that elephants have the right to live in your area? Almost all respondents (91%) replied yes, but Makao and to an extent people from Kabo replied no more often. The variable 'job' (94%) was of highest relative importance followed by the variable 'education' (53%). The best model included the variable 'job' and 'education' with farmers and logging company workers stating themselves to be less tolerant of co-existence with elephants compared to workers from the conservation project. Statements included: "We respect the protection of elephants and the park, because they are very important for the dispersal of seeds" (various workers from the conservation project). "Elephants should stay in the protected area and the government should put a fence around these places so that they cannot come out"; or: "The elephants should leave because we made an error to accept the creation of the park; this is the reason why we cannot improve our livelihoods". "Elephants are bad because they disturb the daily life of the population" (workers from the logging company and farmers from Kabo).

DISCUSSION

Summary of results

Overall, respondents had positive attitudes towards elephant conservation. We found evidence that conservation benefits (working in the conservation project, living in Bomassa) positively shaped the attitudes of people in northern Congo, whereas costs (e.g., experiencing HEC) are often associated with less positive attitudes. This dual role of PAs and wildlife nearby has also been shown in various other studies, but here, we additionally show how that might vary between villages. While the costs of wildlife often outweigh the benefits of conservation (Kansky and Knight 2014), it appears that the benefits of the conservation project (particularly in Bomassa) largely outweigh the costs of HEC both at the household and the village level, likely due to the small size of the village. However, that is different in the village Makao, where fewer

people receive benefits, and these benefits are anyway less valuable than elsewhere. These villagers are forced to find alternative revenue, for example through farming. The benefits are fewer at the household levels and appear not to outweigh the disadvantage due to conservation (e.g. variable 'experienced HEC') and hence villagers here have more mixed attitudes. At the extreme end are farmers in Kabo and Loundoungou that feel not to benefit from conservation and have costs due to the HEC they have experienced.

Effect of village type and the benefits from the conservation project

Respondents from the conservation villages Bomassa and to some extent Makao were found to have more positive responses to elephants compared to logging camps of Kabo and Loundoungou likely due to the tangible benefits which appear to be vital motivational factors for local people to show positive conservation attitudes as found in other studies (Lewis et al. 1990; Gillingham and Lee 1999; Holmes 2003; Gadd 2005; Allendorf et al. 2006; Guerbois et al. 2013). Thus in a small village like Bomassa it appears that integrated conservation and development can be successful. Local support in the conservation villages is further enhanced through decades of environmental education and community outreach programmes that has helped to raise people's knowledge and to foster support wildlife and NNNP (Breuer and Mavinga 2010) as seen elsewhere (Newmark et al. 1993; Hill 1998; Holmes 2003) as seen likewise, respondents from Bomassa had a much better idea about the conservation players and wanted to have even more information on elephant conservation. Interestingly people in Bomassa were more afraid of elephants compared to the other villages, probably due to more regular dangerous encounters with elephants.

Effect of employment

People employed in the conservation project replied much more positively likely due to the direct benefits such as salaries, as has been demonstrated previously (Infield 1988; Riddell 2005; Faïret 2012; Snyman 2014). Simultaneously, people in the other employment categories were less positive about elephants potentially due to the perceived lack of benefits gained from their conservation. While conservation is stated as a major objective within the FSC certified logging concession, it appears that the benefits due to logging activities are not perceived as indirect benefits of conservation (e.g., sustainable exploitation and job guarantee) and likely due to that there is less tolerance of elephants. Some local people also had limited and often inaccurate knowledge of the conservation actors in the area, and believed the PA was created by or for the 'whites', as seen at other sites (Faïret 2012). These 'negative' attitudes might be due to lack of information about the role of each conservation actor. A substantial portion of respondents are not originally from the region and appear to be lacking an understanding of the objectives of conservation

and the particular wide-ranging nature of forest elephants in the landscape. Immigrants (non-residents) have been found to show more negative attitudes and often change traditional values of locals which can ultimately lead to more conflicts about natural resource use and conservation in general (Noss 1997; Guerbois et al. 2013).

As the Congolese law prevents killing of elephants, locals might feel powerless and can show resentment towards elephant conservation, thus their statements might be a form of deep-seated resistance and the lack of participation in resource use decision-making (Parry and Campbell 1992; Gillingham and Lee 1999; Riddell 2005).

Effect of HEC experience

The experience of HEC often negatively impacted respondents attitudes, notably those questions related to tolerance to elephants. This is not surprising, as the strongest local complaints (and likely high costs) were usually about crop-raiding elephants as found elsewhere (Parry & Campbell 1992; De Boer and Baquete 1998; Naughton et al. 1999; Riddell 2005; Guerbois et al. 2013; Snyman 2014). For few respondents killing of problem elephants was perceived as a viable mitigation strategy, while killing of elephants in the forest (for ivory) is seen as a crime. Negative attitudes due to costly HEC might be particular prominent in the absence of help and lack of compensation from the government who is the owner of the wildlife (Naughton-Treves 1997). These negative attitudes also appeared to increase fear towards elephants and reduce the interest in learning more about and seeing elephants. Similarly, people who have experienced HEC in the past tended to state more often that only conservationists (largely ‘white’ ex-pats) care about elephants and not the Congolese people and were not opposed to killing problem elephants (near farms), as this was seen as a mitigation strategy under HEC.

Effect of wealth, education, and ethnic group

Overall, we found relatively little evidence of the impact of income, education and ethnic group on the attitudes towards elephants confirming previous findings (Gadd 2005; Snyman 2014). Similarly, a comparative analysis could show that the above mentioned factors are only weak predictors of attitudes (Kansky and Knight 2014). Those with lower incomes working in farming, natural resource use and other occupations had less positive attitudes towards seeing a killed elephant compared with poorer people working in the conservation project, likely because those often worked in the law enforcement sector for the PA.

Contrary to other studies (Gadd 2005; Riddell 2005; Kideghesho et al. 2007), education also had little impact on people’s tolerance towards elephants with one exception; more educated people stated that Congolese people do not care about elephants. Whereas, only few people had higher education, it is likely that the statement reflects the general lack of Congolese presence in the conservation sector as most activities are

dominated by conservationists (who are not always Congolese) and civil society presence in the area is low. One reason might be seen due to the strong long-term presence of an international conservation NGO and largely absence of local and national conservation approaches, which are likely to have different impacts of people’s attitudes.

Ethnic group was also rarely associated with attitude, with the exception of Aka showing less fear and preferred interest to actually see elephants, likely due to their regular contact with elephants in the forest and their different way of viewing the forest (cosmology). However, these views and traditional values are likely getting more disrupted due to transformation of livelihoods through formal employment in the logging and conservation sector (Riddell 2013).

Limits of the quantitative attitude surveys

The use of quantitative questionnaire surveys is helpful in a rapid assessment of resident’s views towards a conservation problem. Questionnaires provide large sample size and rigorous statistical analysis (e.g., multivariate analysis) to understand how various variables collectively influence conservation attitudes (Brooks et al. 2013). We reduced the potential caveats of quantitative surveys prior to our data collection by using demographic registers to provide a representative sample; by being familiar in the area (reducing non-responses); through appropriate training for enumerators and free, prior and informed consent guaranteeing the anonymity of the respondent (Browne-Nuñez and Jonker 2008; Drury et al. 2011). We also included qualitative results to expand our questionnaire survey to better understand the complexity of factors underlying conservation attitudes. While these complementary data largely supported the questionnaire results, some interview statements also indicated that response bias might occasionally occur and that the concepts underlying these attitudes are complex. Furthermore, some results obtained in this study open up a number of new questions that can be explored with social science techniques (see below) (St. John et al. 2014).

Bias exists when respondents are unwilling to express negative attitudes, particularly when replying to a member of the conservation project about a sensitive issue (e.g., illegal behaviour) (Solomon et al. 2015; Conteh et al. 2015). Furthermore, it is possible that workers of the conservation project have feared that more ‘negative’ replies might cause problems for their job engagement (e.g., response bias) (Browne-Nuñez and Jonker 2008), or provide positive answers to please the interviewer, hence leading to an impression of more positive attitudes. An additional caveat is the lack of clear link between attitudes and behaviour (Kühl et al. 2009; Heberlein 2012) and complementary methods (e.g., Solomon et al. 2007) are needed to whether people are saying the truth in regard to sensitive questions. Additionally given the relatively low level of education, and an education system that largely relies on memorising and repetition (Breuer and Mavinga 2010), respondents statement might not necessarily

provide links to attitudes but rather reflect what people might have heard.

CONCLUSION AND MANAGEMENT RECOMMENDATIONS

We have provided evidence about the positive impact of a long-term conservation project on local people's attitudes towards elephant conservation. The study also identified that the lack of benefits and increased costs, such as the experience with HEC, negatively shape attitudes. When people at the household level perceive the benefits of conservation, the costs can be outweighed, so integrated conservation and development in low population villages as seen in Bomassa and to some extent in Makao is possible, but likely too costly for larger settlements. It is clear from our study that Kabo and Loundoungou residents (mostly logging company employees) do not perceive their benefits coming from conservation and the important link between benefits from timber exploitation, and wildlife conservation in the FSC certified forest is often not considered. Similar failure to acknowledge the ecological and economic importance of conservation have been demonstrated elsewhere (Parry and Campbell 1992; Gillingham and Lee 1999; Gadd 2005). Furthermore our findings demonstrate the need more clearly to explain the role of the various conservation actors (Homewood 2013), particularly due to the presence of an international NGO, and largely absence of local and national initiatives. Regular contact between the wildlife staff and local communities can further improve support (Holmes 2003) and further engagement of people in the decisionmaking of wildlife issues is likely to improve attitudes of residents around NNNP (Riddell 2005). Future surveys should include duration of residency as an explanatory variable (Infield and Namara 2001) as well as measures of household wealth related to owned assets and services (Schreckenberget al. 2010) as well as including more qualitative statements to understand the full dimensions of these negative attitudes; for example: Who are these well-educated logging employees, what is their world view, and what would it take to work with them as conservation allies? Lastly, it is evident that HEC can compromise the long-term conservation efforts of NNNP and its surrounding certified logging concessions and that a strategy of land use planning and measures of mitigation is urgently needed including all stakeholders (Breuer et al. 2016).

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